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REMEDIATION DOCUMENTATION REGARDING TECHNICAL ASSISTANCE REQUEST, DECONTAMINATION APPROACH, AND INTERIM DRAFT REMEDIATION AND FINAL STATUS SURVEY REPORT NS GREAT LAKES IL

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CABRERA SERVICES

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No!

U.S. Nuclear Regulatory Commission

Technical Assistance Request, Heritage Minerals, Inc., Possession and Transfer of Monazite-Rich Product

HPPOS-301 PDR-9306220344

Title: Technical Assistance Request, Heritage Minerals, Inc., Possession and Transfer of Monazite-Rich Product

See the memorandum from R. L. Fonner to J. D. Kinneman dated November 30, 1990, and the memorandum from J. E. Glenn to R. R. Bellamy dated April 29, 1992. The memos response to a TAR from Region I regarding the Heritage Minerals, Inc. ("Heritage"), request which proposed onsite disposal of monazite-rich sands by returning this monazite material to the host material from which it was derived. The disposal of the monazite sands involves complicated issues because the radiation hazard is caused mostly by naturally occurring radioactive materials (NORM) not covered by the Atomic Energy Act (AEA).

Heritage discontinued operations in July 1990, and they have decontaminated their building and equipment in accordance with their license (enclosures). They estimate, however, that 695 cubic yards of monazite sand remain on the site. The monazite-rich sand contains about 2,000 picocuries of thorium-232 per gram based on analysis for actinium-228 and a dry density for the monazite-rich sand of approximately 2.7 grams per cubic centimeter. This sand

resulted from separation of the monazite- rich sands from previously processed subsurface deposits. The licensee has been unable to sell the monazite-rich sand and proposes onsite disposal by mixing it with an estimated 102,500 cubic yards of processed sand located in the salvage storage, recycled tailings, and original new feed areas (also known as the blue and gray areas, after the coloring of maps submitted by the licensee). The licensee intends to also submit a proposal to the State of New Jersey Department of Environmental Protection (NJDEP) to place a deed restriction on the property, cover the sand with a layer of soil, and use the area as a golf course. This approach will dispose of both the NRC licensed sand and the other sand of much lower concentration about which NJDEP is concerned.

Senior personnel of OGC have met to considered the question of NRC regulation of source material under NRC rules and AEA as applied to the areas referred to in License Condition 15 as the "original new feed area", "recycled tailings area", and "salvage storage area". The areas referred to as the gray and blue areas. The problem arises from the fact that the source material content of the materials in these areas is less that 0.05% source material by weight, and therefore represents a preexisting unimportant quantity under 10 CFR 40.13 (a) exempt from

regulation. It should be noted that the AEA required the Commission to establish unimportant quantities (AEA Section 62). The first consensus reached was that regulation could not be based upon a characterization of the areas as having directly licensable material. That is, the contamination is an unimportant quantity (the contamination is clearly not byproduct material).

The second issue was whether the activities in the plant (in the red area) that resulted in separating out a monazite-rich product with source material in excess of .05% by weight provided a basis for jurisdiction over the blue and gray areas. The Commission has asserted jurisdiction over activities of licensees that were ancillary to the primary licensed activity. In the 1970s, the NRC staff relied upon the NEPA theory to condition uranium milling licenses for remediation of mill tailings disposal areas prior to the enactment of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. All of these cases and practices, however, are marked by a feature that distinguishes them from Heritage Minerals. That is, the fact that the ancillary matters regulated under the National Environmental Policy Act (NEPA) theory would not occur or be present but for the primary licensed activity, i.e., the nuclear power plant or the uranium mill.

Initially, the separation of the monazite-rich product was

ephemeral. It was considered a waste and put back into the waste stream. Indeed, during this period the process was not considered a licensable operation. The dry mill tailings were not stored (in the gray area) for reprocessing because of their source material value, but for other minerals such as ilmenite and rutile. Any source material in this feedstock was an unimportant quantity. The gray and blue areas would exist even if no monazite-rich materials were ever separated in the process; thus, the contamination is not the necessary consequence of a licensed (in the Heritage situation-licensable) activity, and which would not occur but for the licensed activity. The consensus is that the NEPA theory provides no basis to regulate the gray and blue areas. This result is consistent with the analogous licensing of side stream extraction of uranium at mineral processing facilities in the western states. The NRC has licensed the side stream extraction of uranium from the effluent of processing of nonsource material ores. In so doing, it has not attempted to regulated the process before the uranium extraction step, nor after, particularly with respect to waste streams. Although OGC is mindful of the staff's concern about the radiation levels in the blue and gray areas, the OGC conclusion is that it is doubtful that NRC should undertake to regulate in the blue and gray areas. Accordingly, we

suggest that License Condition 15 be revised. We see two options, although more may exist. First, remove reference to the areas of questionable regulation altogether, which would leave the question of regulation totally in the State of New Jersey. This option would recognize that the radiation hazard is caused mostly by naturally occurring radioactive material not covered by the AEA (actinium-228 and lead-212 predominate), presenting a legal situation identical to the radium in uranium mill tailings prior to the enactment of UMTRCA, but lacking the NEPA link as discussed above. Second, cover these areas in the license on a basis of acceptance by Heritage, as a voluntary commitment, to adhere to an NRC position (for example, to Option 3 in the Branch Technical Position, 46 FR 52061-52063). In any case the State of New Jersey authorities should be informed and included in any further discussions of this matter. Based upon the conclusions noted above, i.e., that the radiation hazard results predominantly from NORM, we would not consider regulation of the radiation hazards in the blue and gray areas to be preempted.

Regulatory references: Atomic Energy Act

Subject codes: 9.0, 12.9, 12.19

Applicability: Source Material

040-08980
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September 27, 1990

Mr. John D. Kinneman, Chief
United States Nuclear Regulatory Commission
Region I, Nuclear Material Section B
475 Allendale Road
King of Prussia, Pennsylvania 19406

Dear Mr. Kinneman:

As you know, on August 24, 1990, Heritage Minerals Inc. ceased processing and recovery operations at its site near Lakehurst, New Jersey. As a result of this cessation, we have been forced to re-evaluate our plans for decontaminating the site and for transferring or disposing of the monazite. We are writing to let you know of our current plans in that regard.

I also want to thank you for your understanding and flexibility in supporting our decision to begin immediate decontamination of the plant buildings and equipment. Decontamination is currently proceeding smoothly.

Prior to our decision to cease operations at the site, you and I spoke by telephone on August 3, 1990. At that time, you suggested that we prepare a proposed "scheme" for licensing the site in a manner that will be acceptable to both NRC and Heritage. You also requested that we provide you with a brief discussion of our view of the [illegible] tional issues that affect

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NRC's authority over various materials and waste streams which are present at the site. Both discussions follow. We have first presented our view of the legal and jurisdictional issues at the site, which we believe, in turn, justify our proposed licensing and decontamination plans, which follow thereafter.

At the outset, we also want to note our recognition and appreciation for NRC's concerns regarding health and safety issues at the site. It is our hope that these concerns can be fully satisfied without Heritage being forced to relinquish any of its legal rights. Moreover, we recognize and in no way dispute, NRC's right and responsibility to license and regulate certain activities at the site which directly involve the possession, use and transfer of source material.

I. LEGAL AND JURISDICTIONAL ISSUES

As we have noted in our previous telephone conversations, we believe that NRC authority at the Heritage site properly applies to those areas where until recently source material was being generated and processed at the site, i.e., the dry mill, portions of the wet mill and, of course, the monazite storage area. Our view is that other areas of the site cannot properly be considered as within the scope of NRC authority. Our reasons for this conclusion are set forth more fully below

As you know, the primary NRC enabling statute, the Atomic Energy Act, 42 U.S.C. 2071-2112, as amended, grants NRC jurisdiction over "source, special nuclear and by-product material." Special nuclear material is not present at the site so no regulatory requirements relating to its possession and control are applicable. More importantly, NRC controls related to by-product material, although potentially more relevant, are equally inapplicable.

The statutory definition of by-product material is "tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." AEA 11(e)(2), 42 U.S.C. 2014(e)(2) (emphasis added). This same definition is repeated verbatim at 10 C.F.R. 40.4 which, by its own terms, "establish[es] procedures and criteria for the issuance of licenses to receive title to, receive, possess, use transfer or deliver source and by-product material as defined in this part."

The statutory definition of by-product material was enacted by Congress in order to alleviate NRC concerns regarding the scope of its jurisdiction over final disposal of mill tailings at formerly licensed inactive uranium milling sites. See Kerr McGee Corp v. U.S. NRC, Case no. 87-1254 (D.C. Cir. 1990), 1990 U.S. App. Lexis 6437 at p. 5 (stating that "as early as 1960,

the AEC had concluded that because these mill tailings generally could not be classified as source material (their source material content being below the 0.05% by weight stipulated by NRC regulations, 10 CFR 40.4(h)), they lay outside the AEC's statutory licensing authority and therefore beyond its regulatory reach." Id.) See also Final EIS for Uranium Milling NUREG 0706 at p. 13-1,2. Given that NRC's jurisdiction was admittedly limited with regard to wastes from nuclear fuel cycle facilities such as uranium mills, it follows that wastes from a non-nuclear fuel cycle facility that do not result from a process designed to recover source material for its source material content, cannot meet the definition of by-product material and therefore lie outside the scope of NRC's regulatory authority.

While there is source material currently present at the Heritage site, no ores at the site were ever processed by Heritage or its predecessors "primarily for their source material content." Instead, source material was incidentally generated through physical concentration of the naturally occurring monazite as a side effect of the recovery of zircon and titanium. Therefore, it is apparent that no by-product material is present at the site. Given this fact, it logically (and inevitably) follows that NRC regulation of the Heritage is limited to those areas of the site where source material was

possessed, used, processed or transferred. These areas would include the dry mill, portions of the wet mill and the monazite pile.

We recognize that because, at some time during earlier processing activities, monazite waste at source material concentrations was re-combined with other materials and placed in the area marked in blue on the site map, NRC might view the entire area as subject to NRC jurisdiction. We believe such an interpretation would be both unjust and incorrect as a matter of law.

As you know, Mineral Recovery Inc., (and therefore Heritage Minerals Inc. as well) sought and obtained a determination from NRC that the processing at the site did not generate source material. Mineral Recovery Inc. and Heritage Minerals Inc. relied to their detriment, at significant financial risk, upon NRC's determination, which they sought prior to beginning operations. Had they been informed of a different interpretation, they might have altered their process or even declined to begin processing. NRC, not Heritage, made the determination that no source material existed at the site and NRC is bound by its prior interpretation.

In fact, parallels between the issue of NRC jurisdiction over the Blue area wastes and that of NRC's jurisdiction over

uranium mill tailings prior to the amendment of the definition of by product material argue persuasively that NRC does not have jurisdiction over the Blue area wastes even if it had not previously rendered the above noted determination. Given that NRC's position in 1960 was that it lacked jurisdiction over wastes from a licensed nuclear fuel cycle facility's prior operations in which source material was processed for its source material content but that no longer contained source material concentrations, it seems apparent that NRC would similarly lack jurisdiction over waste from past operations in which source material was not processed for source material content and which no longer contains source material concentrations.

Nevertheless, we recognize NRC's concerns regarding the health and safety questions raised by the radium levels in the Blue and Gray areas, even though they do not contain source material. We plan on working with the NRC, in conjunction with the appropriate state authorities, to address these concerns. However, it is clear from statements of NRC itself that radium levels by themselves do not afford NRC a basis for jurisdiction over areas of the site where source (or by-product) material does not appear. See Memorandum of Howard K. Shapar, Assistant General Counsel, to John H. Mcbride. Division of Materials Licensing dated 9/22/65 stating that: "...radium is not

itself within the jurisdiction of the Commission..." Id. at p. 2. See also Naturally Occurring and Accelerator Produced Radioactive Materials, (NARM), 1987 review, NUREG 1310 (March 1988) at pp. 17, 24, 26, 37.

In this regard, it is also helpful to note that the Branch Technical Position Paper Regarding Disposal or Onsite Storage of Uranium Wastes From Past Operations, 47. Fed. Reg. 52061 (October 23, 1981), while an extremely useful guide regarding options for controlling radium concentrations and radon emissions from NRC licensable materials and activities, is not a binding regulation and in any event cannot be considered controlling with regard to materials outside NRC's authority. In fact, as you know, the Branch Technical Position is actually directed primarily toward decommissioning activities at uranium mill tailings sites and not toward sites where source material is generated only incidentally. Nevertheless, we believe the Branch Technical Position paper can be useful in serving as a guideline for Heritage to recover and reclaim the areas of the site not subject to NRC jurisdiction in a manner that will adequately protect public health and safety.

Finally, with regard to the overall issue of NRC jurisdiction, it is important to keep in mind that there are many mining activities which could potentially not be subject

to NRC jurisdiction under a broad interpretation of the scope of NRC's authority based solely on the incidental and undesired appearance of source material at some point in the mining process. Not only would NRC lack jurisdiction, technical expertise and administrative resources sufficient to deal with such activities, NRC would also inevitably encounter very substantial resistance from affected mining operations. In essence, NRC set the 0.05% level defining source material to limit the scope of its regulatory involvement for precisely such reasons. Therefore, as a policy matter of overarching concern, NRC should accept the limits on its jurisdiction, at both the Heritage site and other similar sites, to deal solely with source, special nuclear and by product material as those terms are defined by statute and NRC regulation.

II. PROPOSED LICENSING AND DECONTAMINATION SCHEME

In light of the foregoing discussion and Heritage's decision to close the plant, we have evaluated our alternatives for decontaminating the site and decommissioning the plant. The following discussion addresses our proposed scheme for achieving this result in a manner that we believe will satisfy Heritage's, NRC's and the States' concerns about long-term protection of public health. In particular, it discusses, in turn, our plans for disposing or transferring any source

material present at the site and for addressing the remaining areas of the site where elevated radium concentrations are present.

A. The Monazite Pile/Source Material

Four primary alternatives currently exist for disposing of the monazite pile. These are:

1) to transfer the monazite to another NRC licensee for processing;
2) to dispose of the monazite at sea;
3) to bury the monazite on-site; and
4) to dispose of the monazite at a licensed disposal facility in the western United States.

These alternatives vary considerably, both in their cost and ultimate environmental impact. Each alternative is discussed more fully below.

1. Transfer to Another Licensee

A preferred alternative, for both economic and environmental reasons, would be to transfer this material to another NRC licensee for processing and recovery of the monazite values. Although we are currently searching for a third party willing and able to accept such an arrangement, because this alternative depends upon both market conditions

and the agreement of a third party, it may not become available. In the event that such an alternative does present itself, we trust that NRC would be amenable to granting us the appropriate license.[1/] However, if no such opportunity presents itself, another disposal alternative, as discussed below, will need to be approved.

2. Disposal at Sea

In the event that no licensee is willing or able to accept the monazite for processing, we believe the next most appropriate disposal option would be to disperse the monazite sands at sea. Although we recognize that such a disposal method is somewhat unusual, we believe that it represents an environmentally safe and cost effective means of disposal.

There are a number of important reasons which support this conclusion. First of all, the monazite is itself a naturally occurring radioactive material present in the sand underlying the state of New Jersey. Therefore, to return it to the sea, in a means calculated to effect its dispersal, would simply be to return the material to its natural state.

[1/] In order to facilitate and expedite such a transfer -- especially given volatile market conditions -- we may request approval to transfer the source material at the site prior to obtaining full approval for site decontamination. We are aware that similar approvals have been previously granted in Region I.

Furthermore, monazite is highly insoluble in water and therefore, even in a relatively concentrated state, it poses no danger of radioactive contamination. In the relatively unconcentrated form it would necessarily take before it reached the bottom of sea, and given the relatively small amount of material involved, (approximately 1500 tons of material) it is highly improbable that this material would pose any risk to human health or the environment.

Moreover, this method of disposal would involve relatively little transportation of the monazite, especially in comparison to the transportation necessary to move the material, over public roads, to a disposal site in the western United States. Nor would any permanent radiation risk persist after disposal at sea--unlike disposal on land where the additional monazite would simply add to the permanent residual radiation risk present at the disposal site. For these reasons, we believe that disposal at sea would fully comply with NRC's stated principle of maintaining radiation exposure as low as reasonably achievable ("ALARA").

NRC's regulations at 10 C.F.R. part 20.302(b) specifically authorize NRC to approve of disposal at sea so long as the applicant can demonstrate that disposal at sea offers less harm to man and the environment than other practical methods of

disposal. Although NRC has stated that it will not routinely grant applications for disposal at sea (see 36 Fed. Reg. 23138 (December 4, 1971)), this policy is plainly directed toward disposal of high level radioactive wastes and low level liquid wastes, primarily from vessels and land based nuclear facilities. In fact, NRC has also stated that "[t]he adoption of this rule change does not mean that the commission considers sea disposal of radioactive waste an unsafe practice . . . [and] . . . the Atomic Energy Commission would consider, on a case-by-case basis, applications for disposal at sea." Id. Thus, it is clear that under the proper circumstances, disposal of radioactive waste at sea may present less risk to man and environment than other alternatives and thus be the most appropriate disposal option. We believe the Heritage situation to be exactly such a case. As you know, the Heritage site presents a relatively unique situation, whereby naturally occurring monazite sand was incidentally concentrated, through purely physical processes, to levels above the regulatory threshold. The risk posed by replacing this material in the sea is vanishingly small. While recognizing that disposal at sea is not a routine disposal option, we believe, for the reasons set forth above, that it represents a logical, environmentally sound and health protective option and thus meets the standard set forth at 10 CFR 20.302(b).

3. On-Site Burial

In the event that neither of the previous two alternatives become available, disposal of the monazite through on-site burial would be the most appropriate remaining disposal alternative. Heritage currently owns nearly seven thousand acres surrounding the Heritage Minerals plant site. Burial of the monazite in a relatively remote area, followed by deed restrictions on the relevant property and accompanied by the appropriate passive controls could be achieved in a health protective manner.

4. Disposal At A Licensed Disposal Facility

In the event that no licensee is available to accept the monazite for processing and disposal at sea is deemed inappropriate, Heritage is faced with an unacceptable alternative -- disposal of the material in a mill tailings facility such as the Envirocare facility in Utah or perhaps a licensed low-level radioactive waste site. Because the only presently available disposal sites are currently in the Western United States, such a disposal scenario will involve transportation of the monazite, over public roads, across the majority of the United States. This transportation, in turn, will entail increased risk of human exposure to the monazite, as well as an increased risk of accidents and spillage. Moreover, as noted above, once disposed of at the facility, the

monazite will simply add to the residual radiation present at the site. Nor does it make sense to utilize the very limited radioactive waste disposal capacity for material like the Heritage monazite sands, especially if other disposal options exist.

Finally, and of no small importance to Heritage, the cost of disposal at a western facility will be astronomical in comparison to the alternatives discussed above. Our current estimate is that this disposal method will cost approximately $3,000,000.[2/] Compared with our current estimate of $250,000[3/] for disposal at sea and even less if the monazite is transferred to another party, it is apparent that the expense of disposal in a licensed facility is wholly unjustified and impracticable.[4/] Moreover, as discussed above, such disposal would run counter to the ALARA principle. For these reasons,

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[2/] Based on an estimated cost of $2,000 per ton of material for loading, transportation and disposal fees.

[3/] Based on informal cost quotes from local barge operations, plus loading and transportation.

[4/] In order to place the $3,000,000 figure in perspective relative to the overall size of Heritage Minerals, it is roughly equivalent to the entirety of Heritage Mineral's profits obtained through operation of the mill between the years 1987 to 1990. Thus, an expenditure of this proportion, in order to dispose of a relatively small amount of incidentally generated material is an extremely significant, if not crippling, expenditure for Heritage.

we hope you will agree that this disposal option should be considered by Heritage only as a last resort.

B. Other Areas At The Site

As we have noted above, our current plan is to decontaminate the plant area and any other areas where source material is present at the site in accordance with applicable NRC regulations.[5/] However, based on the discussion above, we believe that several other areas of the site, in particular, the areas where there is no source material present but where elevated radium concentrations exist, although not within applicable NRC jurisdiction, are nevertheless a matter that must be considered. We have previously referred to these areas as the blue and the grey areas (see attached map), which, respectively, represent areas where either Heritage tailings or ASARCO tailings were placed.

We recognize and share NRC's concerns regarding the health and safety issues these areas present. We believe these concerns can be addressed by Heritage acting in concert with appropriate state authority and in consultation with NRC.

[5/] Our current estimate of the cost of decontaminating the plant area is approximately $332,500. This includes the cost of plant decommissioning, clean-up of surrounding areas and the process water pond.

1. The Blue Area

Because of clay "slimes" underlying the blue area, Heritage has been forced to recognize that it will not be physically or economically possible to remove and process the entirety of the material in the blue area. Recognition of this fact contributed to Heritage's decision to cease operations at the site.

Because of these circumstances, Heritage has also been forced to recognize that the blue area will remain permanently unsuitable for residential development. Therefore, Heritage plans, upon consultation and approval from the appropriate state authorities, to cover this area with approximately 4 feet of clean material and to then deed restrict the area for passive use--thereby insuring that no houses will ever be built on this area. Our current plan will be to make passive use of the land, probably as a golf course. A golf course would also likely entail a buffer zone of trees and shrubs.

This plan will result in the loss of at least 50 acres of the Heritage site previously planned for residential development within a golf course parcel. In addition, our estimate of the cost to cover this area is approximately $575,000.[6/] Taken together, the loss of acreage and the cost

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[6/] This estimate is computed on the basis of 2000 tons per acre per foot of coverage. To cover 50 acres with 4 feet of clean material will require 400,000 tons of material at approximately $1.00 per ton. This is followed by land reclamation and vegetation at the cost of $4,500 per acre.

of covering the area represent a very significant financial commitment by Heritage.

2. The Grey Area

Given that the blue area will need to be covered and deed restricted, we also contemplate covering and deed restricting the grey area as well. This would involve the loss of an additional 60 acres and cost an additional $690,000.[1/] Thus, the total cost of covering and deed restricting both the blue and the grey areas will be approximately $1,265,000 and will entail the loss of approximately 120 acres.

3. The Branch Technical Position

By covering material in both the blue and grey areas with four feet of clean material and deed restricting the area for passive use, Heritage's proposal will effectively comply with option 3 of the Branch Technical Position. The Heritage plan will also comply with the ALARA principle, since none of this huge amount of material will be removed or transported from the site over public roads. Therefore, as a practical matter, NRC's health concerns regarding the site should be fully satisfied. As noted previously, we plan on working with the

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[1/] Computed on the same basis as the previous figure. See preceding footnote.

appropriate state agency to achieve the results described above at some point in the future. At that time, we would welcome your consultation and advice as to how to best achieve the desired result.

* * *

We plan on meeting with you soon in order to discuss this more fully. Until then, thank you again for your understanding and cooperation in this matter.

Sincerely,

Michael Thompson for

Anthony J. Thompson
Counsel for Heritage Minerals Inc.

cc: Robert Fonner, Esq.
U.S.N.R.C.

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Form NRC-374

U. S. NUCLEAR REGULATORY COMMISSION
MATERIALS LICENSE

Amendment No. 03

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Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter 1, Parts 30, 31, 32, 33, 34, 35, 36, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s); and to import such byproduct and source material. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. General Services Administration GSA-FSS(FJO)	In accordance with application dated December 11, 1974
2. Room 907, Crystal Mall, Building No. 2 Washington, D. C. 20406	3. License number STC-133 is amended in its entirety to read as follows:
	4. Expiration date April 30, 1981
	5. Docket or Reference No. 040-00341

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Uranium and thorium	A. Various solids	A. As specified in enclosure 1 to licensee's letter dated January 27, 1976

9. Authorized use

A. Storage and repackaging as necessary to storage and transfer.

CONDITIONS

10. Licensed material shall be used only at GSA/FSS Depot, Buffalo, New York; Seneca Army Depot, Kendaia, New York; GSA/FSS Depot, Scotia, New York; GSA/FSS Depot, Somerville, New Jersey; GSA/FSS Depot, Curtis Bay, Maryland; GSA/FSS Depot, Warren, Ohio; Defense Construction Supply Center, Columbus, Ohio; GSA/FSS Depot, Port Clinton, Ohio; GSA/FSS Depot, Hammond, Indiana; GSA/FSS Depot, Jeffersonville, Indiana; GSA/FSS Depot, New Haven, Indiana; U. S. Naval Ammunition Depot, Crane, Indiana; Naval Supply Depot, Great Lakes, Illinois; Granite City Army Depot, Granite City, Illinois; and Savanna Army Depot, Savanna, Illinois.

MATERIALS LICENSE

Supplementary Sheet

License Number STC-133

Docket or
Reference No. 040-00341

Amendment No. 03

CONDITIONS

(continued)

11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 19, "Notices, Instructions and Reports to Workers; Inspections" and Part 20, "Standards for Protection Against Radiation."

12. Except as specifically provided otherwise by this license, the licensee shall possess and use licensed material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated December 11, 1974, and letters with enclosures dated January 27, 1976 and February 9, 1976.

Date APR 23 1976

For the U. S. Nuclear Regulatory Commission

by Radioisotopes Licensing Branch
Division of Materials and Fuel Cycle
Facility Licensing
Washington, D. C. 20555

JAN 27 1976

Ms. K. S. Dragonette
Division of Fuel Cycle
and Material Safety
Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Dragonette:

This will provide the additional information requested in your letters of May 19 and October 31, 1975, and discussed with you by Messrs. J. T. Consiglio and H. R. Oakey of this office, concerning renewal of Source Material License No. STC-133 (Ref. Docket No. 40-341).

1. Composition of Source Materials on Hand:

An inventory listing of our current holdings of source materials is enclosed as Enclosure No. 1. The basis for thorium and uranium contents shown for each material is explained in the accompanying notes. Except for the thorium nitrate and baddeleyite ore, when the other materials were first acquired for the stockpile, data pertaining to uranium and thorium content were not available in all cases, principally because these were stockpiled for emergency uses other than their source material contents.

We have evaluated the physical form of the ores in our inventory and have determined that none of these materials can be classified as "unprocessed" under the licensing exemption provisions of 10 CFR Part 40. For the purpose of this evaluation, we have assumed that these materials were subjected to a certain amount of processing such as washing, screening, classification, etc., subsequent to their removal from their natural place of deposit in nature and prior to acquisition for the stockpile. On this basis, we request that our license be amended to include possession of natural uranium contained in baddeleyite ore as shown in Enclosure No. 1.

Supplemental Sheet 3

2. Environmental Release of Radioactive Materials:

Enclosure No. 1 also details the packaging and storage conditions of our source materials holdings. With the exception of baddeleyite ore which is stored in outdoor piles, all of the other materials are packaged in containers. The majority of these are stored indoors in warehouses. A portion of our monazite sand inventory is stored in bulk in outdoor steel storage tanks similar to silos.

All areas, indoor and outdoor, containing radioactive materials are inspected periodically by a local qualified radiological monitor responsible for each area. In addition, at least twice per year, the Regional Radiological Officer inspects each storage site containing radiological materials within his region. Formal records of these inspections and findings are maintained at the Depots and Regional and Central Offices. Where containers show evidence of spillage or leakage, the probability of release of radioactive materials to the environment is investigated. This includes measurements to determine release of gas daughter products or particulate matter to the atmosphere, surrounding terrain and surrounding water drainage systems. Corrective actions, where necessary, are recommended through the Regional Office to the Central Office, where they are evaluated and acted on accordingly.

Baddeleyite ore, the only radioactive material stored outdoors in bulk, is characterized as chunky in nature and contains little or no fines. The ore piles support vegetation and are covered with grass. This prevents wind and water erosion. The ore is not water soluble, thus it is not expected to leach out into subsurface water tables. Environmental monitorings have been performed at these ore storage locations and all findings have been negative.

As a matter of policy, it has recently been determined that in order to achieve compliance with the provisions of the National Environmental Policy Act of 1969 (NEPA), environmental impact assessments of all stockpile material operations are to be undertaken to formally identify those actions likely to require environmental impact statements. Copies of these assessments covering radioactive materials in the stockpile will be provided your office as they are completed. It is expected that these will become available starting in June 1976.

3. Materials Control Program:

Under our present program, almost all source material transfers out of the stockpile are made by sale to private industry. These sales are made on an AS-IS, WHERE-IS basis. Source material content for these transfers is based on available official GSA inventory records. Where transfer documentation on FORM 741 is required, and source content is not known, best available estimates are used for establishing the amounts transferred. In all cases, standard procedures require that the purchaser must obtain the appropriate licenses from NRC, and submit same for verification, in accordance with the provisions of Section 40.51 of 10 CFR Part 40, prior to our release of the materials purchased.

4. Personnel Technical Qualifications and Training:

Enclosure No. 2 lists the names, qualifications and training of all of the personnel within the National Stockpile program who have radiological safety responsibilities. Refresher training for all Depot personnel who have radiological safety responsibilities is conducted each year by the Regional Radiological Officer.

5. Radiation Safety Program:

Our radiation safety manual entitled "Supplement B to the Strategic and Critical Materials Storage Manual" dated August 1962, is still the basic guide governing the handling of radioactive materials in the Stockpile. Copies of this manual are available at all regional offices and at each depot containing radioactive materials. Updating of this manual is planned in the near future.

In addition, Region 5, Chicago, Illinois, in which the majority of the radioactive materials are contained, has a supplementary manual entitled "Radiological Instructions for Monitors" dated November 1972. This contains safety procedures and is also used for training of depot radiological officers. A copy is enclosed (Enclosure No. 3).

Copies of inventories and survey and inspection reports pertaining to radioactive materials are maintained at the Regional Offices, and at the Central Office. Similar records of receipts and disposals are maintained at each depot, Regional Office and Central Office. Personnel exposure records (film badge readings) are recorded and kept on file covering all affected personnel. In Region 5, these are centrally maintained

at the GSA/FSS Depot, Hammond, Indiana. In Region 2, they are kept at the individual Depots. In Region 3, they are centrally maintained at the GSA/FSS Depot, Curtis Bay, Maryland.

6. Methods of Waste Disposal:

Any radioactive waste materials, both liquid and solids, which are generated as the result of any handling of radioactive materials under License S7C-133, are disposed of in accordance with the provisions of 10 CFR Part 20. Present procedures call for the accumulation of all radioactive waste materials in polyethylene lined steel drums and retained for subsequent disposal through commercial transfer to any one of the firms licensed by NRC to receive such wastes.

Use of the burial ground at the Curtis Bay Depot has been discontinued.

7. Radiation Detection Instrumentation:

Enclosure No. 4 outlines the type and quantity of radiation detection instruments available at each site containing source materials.

Instrument calibrations are performed by the Regional Radiological Officer using material source sets available for this purpose.

8. Other Pertinent Information:

For your convenience, we enclose copies of the following license renewal request supplements, previously sent to your office, which contain pertinent information describing our activities in the handling of radioactive stockpile materials:

Supplement dated 2/17/64, ex License Renewal Request of 2/17/64

Supplement dated 2/17/67, ex License Renewal Request of 2/17/67

Letter dated 6/28/73, H. M. Kirtley to USAEC

We trust that the above provides the additional information requested. We will be glad to discuss any question or render further explanations if needed.

Sincerely,

(signed) E. L. Harper

E. L. HARPER
Acting Assistant Commissioner
Office of Property Management

7 Enclosures

Enclosure #1 - Radioactive Materials In the National Stockpile

Enclosure #2 - Radiological Safety Personnel Training and Qualifications

Enclosure #3 - Radiological Instructions for Monitors Manual

Enclosure #4 - Radiation Detection Instrumentation

Enclosure #5 - Supplement dated 2/17/64, ex License Renewal Request of 2/17/64

Enclosure #6 - Supplement dated 2/17/67, ex License Renewal Request of 2/17/67

Enclosure #7 - Letter dated 6/28/73, H. M. Kirtley to USAEC

cc: ~~xxx~~
Official File- FJM
F
FJ
FJI
FJO
Reading File-FJM

CONCUR: FJO J M Kirtley DATE 1/22/76

FJI James B. Ward DATE 1/22/76

FBCreen 1/22

FJM:ContractOperatiosDivision:JTCONSIGLIO:pmm:1/22/76:70982

J.T. Consiglio 1/22/76

RADIOACTIVE MATERIALS IN THE NATIONAL STOCKPILE

Location & Material	Type of Packaging	Storage	Total Net Wt. Short Tons	Est. Content %		
GSA/FSS Depot, Buffalo, NY						
Columbite/Tantalite transferred to Voorhesville, New York	Steel Galv. Drums	O	948	/4		
Seneca Army Depot, Kendaia, NY						
Columbite/Tantalite	Boxes, Bags, Black & Galv. Drums, Fiber Drums	I	1,357	/4		
GSA/FSS Depot, Scotia, NY						
Columbite/Tantalite	Burlap Bags, Black Steel and Galv. Drums	I	97	/4		
GSA/FSS Depot, Somerville, NJ						
Rare Earth, Chloride,	Painted & Galv. Steel Drums	I	51	0.01	ThO_2	/3
Columbite/Tantalite	Galv. Steel Drums	I	1	/4		
GSA/FSS Depot, Curtis Bay, MD						
Thorium Nitrate	Painted Steel & Fiber Drums	I	2,627	46.01 - 49.18	ThO_2	/1
Rare Earth Chloride	Painted Steel Drums	I	20	0.01	ThO_2	/3
Monazite Sands	Galv. Drums	I	652	3.3 - 9.3	ThO_2	/3
GSA/FSS Depot, Warren, OH						
Columbite/Tantalite	Painted & Galv. Steel Dr.	I	1,357	/4		
Defense Construction Supply Center, Columbus, OH						
Baddeleyite Ore	4 Piles	O	7,125	0.40	U_3O_8	/2
GSA/FSS Depot, Port Clinton, OH						
~~Columbite/Tantalite~~	Black Steel Drums	I	47	/4		

Enclosure No. 1

cation & Material	Type of Packaging	Storage	Total Net Wt. Short Tons	Est. Content %		
A/FSS Depot, Hammond, IN						
stnasite	Painted Steel Drums	I	3,507	0.01 - 0.11	ThO_2	/3
nazite Sands	Painted & Galv. Steel Drums	I	1,279	2.4 - 3.4	ThO_2	/3
orium Nitrate	Painted Steel Drums	I	1,015	46.0 - 47.15	ThO_2	/1
A/FSS Depot, Jeffersonville, IN						
ddeleyite Ore	1 Pile	O	1,052	0.32	U_3O_8	/2
A/FSS Depot, New Haven, IN						
.stnasite	Galv. Steel Drums	I	2,676	0.01	ThO_2	/3
.re Earth Sodium Sulphate	Painted & Galv. Steel Drums	I	3,264	0.10	ThO_2	/3
nazite Sands	Galv. Steel Drums	I	1,663	2.3 - 9.6	ThO_2	/3
ddeleyite Ore	1 pile/Pnt. & Galv.Fib.&Dr,	O	7,815	0.38	U_3O_8	/2
lumbite/Tantalite	Wooden Kegs, boxes, bags.					
.S. Naval Ammunition Depot						
ane, IN						
lumbite/Tantalite	Black Steel Drums & Wooden Kegs	I	113	/4		
~~aval Supply Depot, Great Lakes, IL~~						
~~nazite Sands~~ sold (summer 78)	Steel Storage Tank-Bulk	O	2,360	3.18	ThO_2	/3
ranite City Army, Granite City, IL						
olumbite/Tantalite transferred to New Haven, IN	Painted & Galv. Steel Drums	I	407	/4		
avanna Army Depot, Savanna, IL						
are Earth Sodium Sulphate	Painted & Galv. Steel Drums	I	1,339	0.08 - 0.12	ThO_2	/3
olumbite/Tantalite	Wooden Kegs, Black & Galv. Drums	I	200	/4		

NOTES TO ENCLOSURE NO. 1

O: Outdoor Storage
I: Indoor Warehouse Storage

1. Material made up of various lots, each having source material content within ranges shown. Content based on data supplied on acquisition.

2. Content based on data supplied on acquisition of material.

3. Content shown is estimated based on spot samples taken at various times.

4. Contents unknown, but estimated to average 0.04% combined Th plus U, based on spot samples taken at various times. See Enclosure No. 1 to letter H. M. Kirtley to USAEC dated 6/28/73.

GENERAL SERVICES ADMINISTRATION

RADIOLOGICAL SAFETY PERSONNEL
TRAINING and QUALIFICATIONS

GSA - Central Office - Washington, DC

Office of Property Management

Mr. J. T. Consiglio - Director, Contract Operations Division
Employed U.S.A.E.C., 1947 - 1966

1. Site Representative, Middlesex Sampling Plant, Middlesex, NJ, 1947 - 1955

2. Technical Services Division - CANEL Project Office Middletown, CT, 1955 - 1966
SS Accountability Representative and Safety Officer

Has Bachelor Mechanical Engineering degree and PE License (NY State)

Mr. Harry Oakey - Chief, Minerals and Ores Branch

Radiological Monitoring Course
Storage Management Officer

Mr. Bill R. Green - Quality Inspection Specialist

B.S. in Geology

Region 2 - New York

Regional Radiological Officer

Mr. Uldis Pauga, Quality Assurance Specialist
Satisfactorily completed training in 1974 at the Defense Civil Preparedness Agency, Staff College, Battle Creek, Michigan, in following:

Radef I - Basic Concepts of Civil Defense Radiation Control
Radef II - Radiological Defense Officer
Radef III - Radiological Instructor Workshop

Has B.S. degree in Metallurgical Engineering

Enclosure No. 2

Alternate Regional Radiological Officer

Mr. Louis Maldonado - Quality Assurance Specialist
Has received training from Mr. Pauga and also completed training in Radef I, II, and III on August 8, 1975. Has an AAS degree in Chemical Technology.

Seneca Army Depot

Alpha Monitoring Team. This is a group of radiological specialists for the Army who are stationed at Seneca Army Depot for radiological safety control matters. The Depot Radiological Officer is Mr. Martin J. Way. He received training in "Radiation Health #211" given by the USPHS, Rockville, Maryland.

GSA-FSS Depot - Scotia, NY

Mr. P. Saglimbeni - Depot Manager
Mr. F. Suhr - Assistant
Training received from Regional Radiological Officer.

GSA-FSS Depot - Somerville, NJ

Mr. D. Beam - Depot Manager
Mr. J. Cucchiaro-Assistant
Training received from Regional Radiological Officer.

GSA-FSS Depot - Buffalo, NY

Mr. G. Gustaferro - Depot Manager
Mr. T. Llewellyn - Assistant
Training received from Regional Radiological Officer.

Region 3

GSA-FSS Depot - Curtis Bay, MD

Mr. Albert Bauchman - Depot Manager
Indoctrinal Radiation Course-1963 - GSA
Radiological Monitors Course at Howard University, Washington, DC, March 1969
DOT Seminar - Hazardous Materials - Newark, NJ, March 1975

Region 5

Regional Radiological Officer

Mr. Harry Szczepanski - Quality Assurance Specialist
OCD Staff College, Battle Creek, MI - 40 hours
Radiological Monitoring Course - 32 hours

GSA-FSS Ca..d Depot - New Haven, IN

Mr. Ray Hardcastle - Assistant Storage Manager
Radiological Monitoring, Southern Illinois Univ. - 40 hrs.
Radiological Monitoring Course - 16 hours

GSA-FSS Warren Depot - Warren, OH

Mr. Jack Donohue - Assistant Storage Manager
OCD Staff College, Battle Creek, MI - 40 hours

Defense Construction Supply Center - Columbus, OH

Mr. Joe Rodgers - Radiation Protection Officer
Basic Radiological Protection, Winchester, MA - 80 hours

U.S. Naval Ammunition Depot - Crane, IN

Mr. J. P. McDonald - Radiation Safety Officer
Radiological Monitoring, Aberdeen Proving Grounds -40 hours
BS Degree in Chemistry

GSA-FSS Erie Depot - Port Clinton, OH

Mr. Ralph Gedling - Storage Manager
Radiological Monitoring Course

GSA-FSS Depot - Hammond, IN

Mr. John Stefanchik - Storage Manager
Mr. Joe Ford - Warehouse Foreman
Radiological Monitoring Course - 32 hours each

GSA-FSS Depot - Jeffersonville, IN

Mr. Don Fish - Storage Manager
Radiological Monitoring Course - 32 hours

Naval Supply Depot - Great Lakes, IL

Lt. Tom Hinz - Radiation Protection Officer
Armed Forces Radiological and Biological Institution - 3 yrs.
National Institute of Health - 1 year
Certified Radiation Physicist

Granite City Army Depot - Granite City, IL

Mr. Jodie Doss - Radiation Protection Officer
Radiological Protection Officer - 40 hours
Aberdeen Proving Grounds, MD

Savanna Army Depot - Savanna, IL

Mr. Don Chew, Radiation Protection Officer
BS Degree in Physics.

ENCLOSURE #3

"Radiological Instructions for Monitors"

Manual

encl. #3

R ATION DETECTION INSTRUMENTATIC

GSA Central Office

Instrument	Quantity
Survey Meters	
Eberline E-500 B	1
CDV-700	1
CDV-710	1
CDV-715	1
CDV-720	1
CDV-750	
Dosimeters	
CDV-138	6
CDV-730	4
CDV-742	1
CDV-750	3

Region 3, Washington, DC

Instrumentation located at GSA-FSS Depot, Curtis Bay, Maryland.

Instrument	Quantity
Survey Meters	
Eberline PAC 1SA	1
Eberline PAC 2G	1
Eberline E-500B	1
Alpha Survey Meter ASM-94	1
Jordan 710	1
CDV-700	1
Dosimeters	
CDV-138	1
CDV-730	1
CDV-740	1
#362	1
DIR-128	1
CDV-750	1

Region 2, New York

Instrument	Somerville	Belle Mead	Bingh.	Scotia	Seneca *	Buffalo **
Survey Meter						
CDV-700	11	1	3	2		
CDV-715	7	2	3	1		
CDV-717	1		1	2		
Geiger Counter						
E500 B	1		1	1		
Dosimeter						
CDV-138	4	4	2	6		
CDV-730				4		
CDV-740	2		3	4		
Dosimeter Charger						
CDV-750	2	1	1	1		
	28	8	14	21		

* U.S. Army Instruments
** Instruments Brought From GSA Binghamton Depot When Required.

RADIATION DETECTION INSTRUMENTATION

REGION 5 - CHICAGO

Instrument	Regional Radiological Officer	Casad	Warren	Columbus	Crane	Erie	Hammond	Jeffersonville	Great Lakes
Survey Meters									
[illegible]592B					1				
CDV-700	16	2	2			3	2	3	
CDV-715	2	1	1			1	1		
CDV-717	2	1	1			2	1	2	
Eberline PAC 1SA	1								
Eberline PAC 2GA	10								
Eberline E 500 B		1					1		
Eberline 520					1				
ANDPR-27				2	1				1
ANDPR-56					1				
Eberline 140									1
Nuclear Chi-2612				1					
Dosimeters									
CDV-138	10	11	7			8	11	7	6
[illegible]-730	64	6	5			8		6	
[illegible]-740	6	6	5			8	12	7	
CDV-742	5								
Victoreen 541A					20				
Victoreen 656A					20				
Bendix					1				

RADIATION DETECTION INSTRUMENTATION

REGION 5 - CHICAGO

Instrument	Regional Radiological Officer	Casad	Warren	Columbus	Crane	Erie	Hammond	Jeffersonville	Great Lakes	Granite City	Savann
Survey Meters											
[illegible]592B					1						1
CDV-700	16	2	2			3	2	3			
CDV-715	2	1	1			1	1				
CDV-717	2	1	1			2	1	2			
Eberline PAC 1SA	1										
Eberline PAC 2GA	10										
Eberline E 500 B		1					1				
Eberline 520					1						
ANDPR-27				2	1				1	1	1
ANDPR-56					1						1
Eberline 140									1		
Nuclear Chi-2612				1							
Dosimeters											
CDV-138	10	11	7			8	11	7	6		
[illegible]-730	64	6	5			8		6			
[illegible]740	6	6	5			8	12	7			
CDV-742	5										
Victoreen 541A					20						
Victoreen 656A					20						
Bendix					1						

APPLICATION FOR RENEWAL OF
SOURCE MATERIAL LICENSE

February 17, 1967

SUPPLEMENT

Renewal of Source Material License No. STB-133

General Services Administration
Property Management and Disposal Service

Item 13.

We will not be generating a waste product as such, but we will generate a small quantity of waste rags and sawdust from cleanup and decontamination made necessary by leaking containers of thorium nitrate at our Hammond, Indiana, facility. The thorium nitrate is contained in 55-gallon size steel drums with gasketed head and clamp ring. All containers have double polyethylene liners which were heat sealed at time of packaging. In the past three years, we have accumulated 28 leaking containers. All of the leaking containers involve a small hole or two located generally from the area of the chimes to the bottom outside wall. Very close observation of the storage is maintained and upon detecting a leaker, it is segregated from sound containers and decontamination action is handled immediately. The leaking containers are then placed on their sides to continue in storage with the leaking area in the "up" position. A glass fabric and a bituminus substance is applied over the leak to curtail further deterioration of the container.

Due to extremely close surveillance of storage, we have been able to detect leaking containers at an early stage and therefore have kept decontamination requirements at a minimum. To the present, we have accumulated about 150 pounds of sawdust, rags, and other cleanup residues. These wastes are contained in two sound 55-gallon size steel drums with lids, and stored in the same general area as the thorium nitrate. After we have accumulated an appropriate quantity of such waste, it is our plan to dispose of it by contract with one of the existing licensed radioactive waste disposal companies.

In the meantime, in coordination with other elements of AEC, who have experienced the same problem from leakers, we are working towards a solution either through a different method of packaging or other means which may be acceptable. Any action decided upon, which may involve the scope of our license, will be brought to the attention of AEC's Source and Special Nuclear Materials Branch, Division of Materials Licensing.

February 17, 1964

SUPPLEMENT

Renewal of Source Material License No. STB-133, General Services Administration, Defense Materials Service.

Item 4.

1. GSA-DMS Depot, Curtis Bay, Baltimore, Maryland
2. GSA-DMS Depot, New Haven, Indiana
3. GSA-DMS Depot, Hammond, Indiana
4. GSA-DMS Somerville Depot, Somerville, New Jersey
5. Granite City Army Depot, Granite City, Illinois
6. Naval Supply Depot, Great Lakes, Illinois
7. Savanna Army Depot, Savanna, Illinois
8. Ravenna Army Ammunition Plant, Ravenna, Ohio

Item 10.

Each location has an assigned radiological officer, who in turn has been trained by one or more of the following:

1. Civil Defense Training Center, Brooklyn, N. Y.
2. Civil Defense Training Center, Battlecreek, Michigan
3. DMS Radiological Training Team
4. Naval Laboratory, Port Hueneme, California
5. U. S. Army Radiological Safety School, Ft. McClellan, Ala.

Each depot radiological officer is supervised and kept up to date by a qualified officer of a higher command. For example, the work of the radiological officers at depots 5, 6 and 8, are supervised and guided by personnel out of the Surgeon General's office of the respective Army area. The radiological officer of depot 6, is guided by the Industrial Manager out of the Commandant's office of the Ninth Naval District. The radiological officers of depots 1 through 4 are guided by a qualified officer in the region, who in turn is advised and guided by a qualified technical officer from Washington, D. C. Any unusual matters of work or action required is completely coordinated by and through DMS, Washington, D. C., regardless of the depot involved.

Item 11b.

Due to the low level of radiation involved and the extremely light usage of instruments entailing periodic inspection of dead storage, we have had no requirements for adjustments or calibration of instruments. However, whom each a requirement developes we will arrange a method and standard which will be adequate to meet requirements. In the meantime, routine checking of each instrument with their respective source sample at intervals depending on the usage and maintenance of the instrument, should be satisfactory in determining a reasonable degree of accuracy. Pocket dosimeters are recorded on a daily basis and film badges are developed and recorded on a monthly basis, or sooner, if determined to be necessary.

Item 12. (a), (b) & (c)

Refer to Supplement D to the Strategic and Critical Materials Storage Manual, as revised, August 1962, titled "Radiological Safety Procedures for Storage and Handling of Stockpiled Strategic Materials." Prior to the publication of this manual, concurrence was gained from all Government offices concerned.

Army, Navy, Air Force and GSA depots involved in stockpile work have copies of this manual on hand for reference in handling radioactive stockpile materials as appropriate. In addition, the manual offers guidance for handling general stockpile commodities, under conditions of national emergency. All Army and Navy facilities involved have their own individual programs for training and refresher courses for monitors, etc., and similar work is also carried on by GSA regional personnel. An example of GSA regional participation in radiation work is enclosed for your convenience. -- It is titled "Radiological Instructions to Monitors" and is dated November 1961. Each GSA regional office has a similar program to keep assigned monitors and officers up to date and well advised.

APPLICATION FOR RENEWAL OF
SOURCE MATERIAL LICENSE

February 17, 1967

SUPPLEMENT

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General Services Administration
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In the meantime, in coordination with other elements of AEC, who have experienced the same problem from leakers, we are working towards a solution either through a different method of packaging or other means which may be acceptable. Any action decided upon, which may involve the scope of our license, will be brought to the attention of AEC's Source and Special Nuclear Materials Branch, Division of Materials Licensing.

February 19, 1998

MEMORANDUM TO: License File No. SUC-01332
Engelhard Minerals and Chemicals
Philipp Brothers Division

THRU: Bruce L. Jorgensen, Chief Orig. Signed by W. Snell for
Decommissioning Branch

FROM: Edward L. Kulzer
Radiation Specialist

SUBJECT: CLOSE OUT OF THE LICENSE FILE

The terminated License File No. SUC-01 332 was forwarded to Region III for follow up as part of the Oak Ridge National Laboratory Terminated Sites Review because it lacked closeout surveys regarding a portion of the decontamination activities when the license was terminated. This license involved the storage, loading and shipment of monazite sand. This License involved the Great Lakes facility. The License was for Engelhard Minerals and Chemicals, Philipp Brothers Division, U.S.N.A.C. Supply Depot, Great Lakes, Illinois.

Monazite sand was stored in tanks until it was removed and shipped offsite. After the work was completed, Health Physics Associated out of Highland Park, Illinois was contracted to decommission the area and equipment. When the sand was removed from the tanks, the tanks were sandblasted to remove residual radioactivity and dismantled. The equipment used was decontaminated inside the tanks using a high pressure hose. Tarpaulins were placed on the ground during the loading of drums to capture any spillage of material. Tarpaulins were also used as wind screens during drum loading. The grounds were surveyed and found to be in compliance with NRC guidelines.

A description of the work that was done and the final decommissioning of the tanks at the Great Lakes site was sent to NRC from the Defense Logistics Agency in a letter dated May 9.1984. NRC had no comments or questions on the work that was done.

Based on the above information Region III considers License File No. SUC-01332 closed. No further action regarding this License will be taken.

bcc: J. Buckley, NMSS
B. Snell, RIII

DOCUMENT NAME: G:\SEC\ENGLEH.CLO

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OFFICE	RIII	C	RIII	C		
NAME	Kulzer:ib		Jorgensen			
DATE	02/18/98		02/19/98			

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Home Page

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License Document Keywords

Summaries

Region I
Region II
Region III
Region IV

What We're Doing

Talk To Us

NRC Terminated License Tra

Searching License Numbers in Region All

Select License

SMC-01207 OK

Information regarding license number SMC-01207

Names and Addresses

Name	ENGELHARD MINERALS AND CHEMICALS-PHI
Address	299 PARK AVE., NEW YORK, NY
City	NEW YORK
State	IL
ZipCode	10017
Site of Operation	RAVENNA OHIO; SAVANNA ILL ARMY DEPOT;
State of Operation	IL

General Data

Type	Site License
Region	III
Part	40
Job	0081
Box	18
Site Score	52.67
Sealed Score	NA
Closed Out	No

Action Records

Reference Filename	Reference Date	Action Date	Action Code	Closed Out Date	Date Entered	C

DL-080299_01.pdf			CO		25-Aug-99	C re
ML052560100		09/12/2005	IR		10/03/06	Sl El
DL-080999_01.pdf			CO		06-Oct-99	Si D 2(re te 1! ac Tl by
	01/01/1900	9/20/95	RR			
	01/01/1900	9/20/95	RR			
	01/01/1900	3/1/95	CO	3/1/95		
DL-030195_04.pdf	03/01/1995		CO		12/4/98	Tl re di lic ou Al in in th sa m nc
DL-030195_04.pdf	03/01/1995		FR		12/4/98	Tl re di lic
DL-062393_01.pdf	06/23/1993		NA		12/4/98	
DL-072794_01.pdf	07/27/1994		NA			D
ML012710539	09/26/2001	9/26/2001	RO		07/15/04	Tl in of Jc

Licensee Address and Contact Information By Action

Entry Number	Licensee Address

1625	Engelhard Minerals and Chemicals NA,
1844	Engelhard Minerals and Chemicals John Pittano Warren Depot Pine Street Extension Warren, OH, 44482 216-652-1456
2162	Engelhard Minerals and Chemicals John Pittano Warren Depot Pine Street Extension Warren, OH, 44482 216-652-1456
2392	Engelhard Minerals and Chemicals NA,
3110	Engelhard Minerals and Chemicals Ravenna, OH,
3413	Engelhard Minerals and Chemical Corporation, Philipp
45408	Department of the NAVY Steve Doremus NAVSEADET RASO NWS P.O. Drawer 260 Yorktown, VA, 23691

Region Contact/Referral Information By Action

Entry Number	Region Office	Contact	Phone	Referral Date	Response Date
1625	1	Richard W. Cooper			
1844	3	Ed Kulzer			
2162	3	Ed Kulzer			
3110	3				
3413	1	Andrew J. Schwartz			
45408	3	Jamnes L. Cameron			

State Contact/Referral Information By Action

Entry Number	State	Office	Contact	Title	Phone	Referral Date	Response Date	Stat Lice Nun

Email comments to The WebMaster.

INTERIM DRAFT REPORT-*Not for Public Distribution*

Radiological Remediation and Final Status Survey
Former Monazite Sand Storage Area

Naval Station Great Lakes – Great Lakes, Illinois

Project USN 2006-009
CABRERA Project Nos. 03-3040.30
Contract No. DAAA09-02-D-0024, Delivery Order 0030

Prepared for:

U.S. Army Field Support Command
Rock Island, Illinois

Prepared by:

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

473 Silver Lane
East Hartford, CT 06118

April 2008

Executive Summary

Cabrera Services, Inc. (CABRERA), under contract to the United States (U.S.) Army Joint Munitions Command (JMC), performed characterization, remedial, and final status survey (FSS) activities within the remaining areas of the former Monazite Sand Storage Area (FMSSA) at the Naval Station Great Lakes in Great Lakes, Illinois, hereafter referred to as the 'Site'. The Site is shown in the Site Map presented as Figure 1.

Field work performed during the 2007 calendar year was performed under previously prepared CABRERA work plans entitled, *Work Plan for the Characterization of the Recreation and Center Tank Areas and Radiological Remediation and Final Status Survey of the North Fence Area* (CABRERA, 2004b), *Work Plan for the Remediation of the Recreation and Center Tank Areas and Site Wide Final Status Survey* (CABRERA, 2004d), .and *Public Private Venture Area Remediation Addendum* to *Work Plan for the Remediation of the Recreation and Center Tank Areas and Site Wide Final Status Survey* (CABRERA, 2007) These Work Plans governed all field activities performed during this project. All activities were performed under the oversight of Naval Sea Systems Command Detachment (NAVSEADET) Radiological Affairs Support Organization (RASO).

The field activities described herein were performed concurrently with the remediation field activities within the Public Private Venture (PPV) area of the site. However, the results and conclusions discussed in this report only apply to the Former Monazite Sand Storage Area. The PPV area requires additional work to be completed and therefore results for these areas will be provided under separate cover. The FMSSA includes survey units (SU) 1, 2, 3, 4, 5 as shown on Figure 2, as well as SUs 17 and 18 (the latter two for the former soil stockpile).

Project activities performed during the most recent mobilization included:

- Gamma Walkover Surveys (GWS) in all accessible areas;
- Direct-push soil coring and downhole gamma logging (DGL);
- Surface and subsurface soil sampling at systematic and biased locations;
- On-site laboratory soil preparation and gamma spectroscopy analyses;
- Development and submission of site-specific derived concentration guideline level (DCGL) document for the Site. This document was approved by NRC Region 3 and thus allowed a 4 picoCuries per gram (pCi/g) Thorium-232 (^{232}Th) DCGL to be used henceforth;
- Excavation and remediation of Site soils containing ^{232}Th greater than the DCGL, including the soil stockpile remaining from remediation activities in the former monazite sand storage area performed in 2004. The stockpile was leveled with a *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; U.S. Nuclear Regulatory Commission [NRC], 2000) Final Status Survey (FSS) performed in two sequential 1-foot lifts;
- Packaging and shipment of 102 tons of impacted excavated soils;

- Performance of a post-remediation, MARSSIM FSS within each SU.
- Site restoration activities, including backfill of completed excavation areas.

Soils exceeding the DCGL of 4 pCi/g ^{232}Th were packaged in 10 cubic-yard (CY) soft-sided containers, (i.e., super-sacks). Each super-sack was found to hold approximately 8.5 tons of soil. The super-sacks were temporarily stored on-site, then transported to a nearby railhead in Kenosha, Wisconsin, where the containers were transloaded into gondola railcars. The wastes were profiled for disposal at the Waste Control Specialists (WCS) facility in Andrews, Texas, as unimportant quantities of source material (less than 0.05% by weight, or equivalent to 55 pCi/g of ^{232}Th). The highest concentration of ^{232}Th identified in these soils was 32 pCi/g.

FSS activities consisted of a 100% GWS and sample collection and analysis. Systematic and biased sampling consisted of soil sampling from 120 locations, with samples obtained via a direct-push rig with a macrocore sampler or through surface sampling methods.

All FSS sample results were shown to be below the Site DCGL of 4.0 pCi/g. The FSS data indicate that the Site is suitable for release for unrestricted use.

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ACRONYMS AND ABBREVIATIONS

^{228}Ac	Actinium-228
AEC	Atomic Energy Commission
AFSC	United States Army Field Support Command
^{241}Am	Americium-241
^{214}Bi	Bismuth-214
CABRERA	Cabrera Services, Inc.
CFR	Code of Federal Regulations
^{60}Co	Cobalt-60
^{137}Cs	Cesium-137
cy	Cubic Yard
DCGL	Derived Concentration Guideline Level
DOT	U.S. Department of Transportation
DRMO	Defense Reutilization and Marketing Office
EMC	Elevated Measurement Comparison
ft	Feet
FSS	Final Status Survey
FWHM	Full Width at Half Maximum
g	Gram
GIS	Geographic Information System
GPS	Global Positioning System
GWS	Gamma Walkover Survey
HEPA	High-Efficiency Particulate Air
HPGe	High Purity Germanium
in	Inch
^{40}K	Potassium
keV	kiloelectron Volt
m	Meter
m^2	Square Meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
µR/h	Microroentgen per Hour
NAD	North American Datum
NaI	Sodium Iodide
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
NAVSEADET	Naval Sea Systems Command Detachment
^{214}Pb	Lead-214
pCi/g	Picocurie per Gram
QA	Quality Assurance
QC	Quality Control
RA	Recreation Area
^{226}Ra	Radium-226
RASO	Radiological Affairs Support Organization
ROC	Radionuclide(s) of Concern
^{222}Rn	Radon-222
SOW	Scope of Work
SU	Survey Unit
TCLP	Toxicity characteristic leachate procedure
^{232}Th	Thorium-232
U-235	Uranium-235
U.S.	United States
WAC	Waste Acceptance Criteria

1.0 INTRODUCTION

CABRERA performed characterization, remediation, and FSS activities within the former FMSSA at the Naval Station Great Lakes in Great Lakes, Illinois (hereafter referred to as the Site). Activities during 2007 focused on areas of the Site requiring additional investigation, remediation, and final status survey based on the results of the investigations performed in the 2003-2004 timeframe. These areas are referred to as survey units (SU) 1 through 5, 17, and 18 throughout this document. Remedial and survey activities were performed under contract to the US Army Joint Munitions Command (JMC) and the oversight of the US Navy's Naval Sea Systems Command Detachment (NAVSEADET) Radiological Affairs Support Organization (RASO).

1.1 Background

Monazite is a rare earth phosphate containing a variety of rare earth oxides particularly cerium and thorium oxide. Thorium has wide industrial applications and has been mined as monazite sand since the 1930's. In 1974, the Atomic Energy Commission (AEC) granted license #STE-8179 to Engelhard Minerals & Chemicals Corporation, authorizing the package and shipment of a strategic pile of monazite sand from the Site. It is reported that this sand was shipped to Holland that same year. The AEC also granted license #SMC-12078179, authorizing "Repackaging of monazite sands in U.S. Department of Transportation (DOT) approved containers." These operations were confined to the following locations: Savannah Army Depot, Savannah, Illinois; Army Ammunitions Plant, Ravenna, Ohio; and U.S. Navy Administrative Command, Supply Depot (currently referred to as Naval Station Great Lakes), Great Lakes, Illinois. This former AEC license indicated that 1,826,153 pounds of monazite sand containing 9.226% of thorium oxide was held at the Naval Station prior to shipment off-site. Records show that monazite sand was shipped to W.R. Grace & Company, Chattanooga, Tennessee. The sand was shipped from Great Lakes and Savannah, Illinois from early September through mid-October 1974; and from Ravenna from early November through mid-November 1974. There is limited information on the extent of residual contamination resulting from these operations. No records have been found indicating that a closeout survey of the monazite sand storage area (current Site) was conducted, prior to CABRERA'S efforts beginning in 2000.

1.2 Previous Site Activities

NRC Region III conducted an inspection in January of 2000, and found several locations of elevated gamma activity on the north side of the former monazite sand storage area near the northern boundary. Surface exposure rates of 80 microRoentgen per hour (μR/h) were observed along the North Fence Area northern boundary. CABRERA was contracted by the Navy to assess the area.

On March 8, 2000, CABRERA performed a detailed characterization which identified several locations of elevated gamma activity, and by gamma spectroscopy, identified the presence of ^{232}Th. CABRERA characterized the area formerly known as Tank Farm #5. The Tank Farm was surveyed and surface soil samples were collected and analyzed for ^{232}Th. Gamma

radiation levels above the ambient level were identified along the north fence line in locations between and surrounding tanks H, L, and K (see Figure 3). During the survey, six soil samples were collected from areas where elevated gamma radiation levels were observed. These samples were analyzed for ^{232}Th using gamma spectroscopy. Analytical results for the samples indicated that ^{232}Th concentrations ranged from 0.93 pCi/g to 64.31 pCi/g, with an average activity concentration of approximately 17 pCi/g. CABRERA also performed FSS activities during 2000, and released the areas surrounding the warehouse Building 8012. These released SUs were part of the area referred to as the construction zone. FSSs recommending unrestricted/restricted release were accepted by the NRC.

During the 2003 characterization survey, soil samples were collected from the soil pile and North Fence Area to provide information regarding chemical contaminants that could affect disposal options. Laboratory analyses performed were in accordance with U.S. Ecology Waste Acceptance Criteria (WAC) requirements. These analyses included a toxicity characteristic leachate procedure (TCLP), total metals, mercury, semi-volatiles, volatiles, chlorinated herbicides, and organochlorine pesticides. The sample analytical results were below 40 Code of Federal Regulations (CFR) Part 261 land disposal limits, indicating that no hazardous chemical constituents were identified.

In 2004, CABRERA was contracted to remove the soil pile and characterize the remaining soils. The soil pile, prior to remedial activities, covered an area approximately 100 feet by 50 feet and was approximately 16 feet high. The soil pile was reconfigured in order to ease remediation and to ensure uniformity between the SUs. The remediation occurred incrementally, as one foot lifts of soil from the pile. Each lift was evaluated as a MARSSIM Class 1 SU prior to its removal. Most of the soil pile was suitable for release for unrestricted use, approximately 1,730 cubic yards (cy). This soil was beneficially reused to provide additional capping material for a nearby, on-site landfill. Approximately 70 cy of soil from the soil pile exceeded the DCGL and were disposed off-site at the U.S. Ecology Grandview, Idaho facility as unimportant quantities of source material. The highest concentration of ^{232}Th identified in these soil pile soils was 2.7 pCi/g.

Characterization surveys were performed on the base of the soil pile and the one foot soil layer beneath it. ^{232}Th concentrations ranged from -0.13 to 1.1 pCi/g. The characterization surveys also identified elevated concentrations of ^{226}Ra at the base and beneath the soil pile (southeast corner), with concentrations as high as 120 pCi/g; During the sampling process, the remnants of a 'sound powered phone jack' containing radium, as characterized by DoD personnel, was found below ground level near the this area of the soil pile. The elevated ^{226}Ra results are likely due to contamination from this debris.

Additionally, the scope of CABRERA'S 2004 contract also included remediation and FSS of the North Fence Area. Following the direction of RASO, only characterization surveys were performed for the North Fence Area; however, these North Fence Area characterization surveys were performed using MARSSIM FSS guidance and were to be used to support future North Fence Area FSS evaluations. Based on the survey results, approximately 170 cy of North Fence Area soils exceeded the DCGL of 1 pCi/g and were disposed of off-site at the U.S. Ecology Grandview, Idaho facility as unimportant quantities of source material. The highest concentration of ^{232}Th identified in these soils was 8.6 pCi/g.

As part of the removal action, CABRERA characterized the remainder of this portion of the Site, with results published in a Technical Memorandum. It was estimated that an additional 1,526 cy of material required remediation. As part of the previous activities, CABRERA performed remediation in the Center Tank Area and the area just south of the Center Tank Area referred to as the Recreation Area. FSSs in the Center Tank Area performed by CABRERA and scoping surveys completed by the NRC showed additional areas of contamination above the existing clean-up goal of 1 pCi/g above background (NRC default surface soil screening value). This included some areas at the boundary of the original footprint remediated at a greater depth than anticipated and over a larger area than previously identified. Additionally, the NRC identified contamination up to 20 pCi/g at the headwall of a drainage pipe that empties into Skokie ditch. The headwall is in the northern portion of the industrial area.

In 2006, CABRERA performed radiological surveys which were used to develop the remediation approach used during these final activities. The Navy demolished Tank H and the nearby storage building so the 2007 remediation activities could be completed.

1.3 Radionuclide of Concern

The ROC associated with monazite sand is natural thorium and its decay products. The monazite stored at Site 18, was unaltered and unprocessed, thereby preserving the natural concentrations and secular equilibrium. There is no evidence of chemical or physical processes that would disturb this equilibrium.

Soil analysis results from the 2000 and 2004 characterization surveys (CABRERA 2000 and 2004a) confirmed the presence of ^{232}Th, in secular equilibrium with its progeny, as the Site ROC. Monazite sand typically contains 5-7% radioactive thorium and 0.1-0.3% radioactive uranium. Isotopes from the thorium series naturally dominate, and while uranium series radionuclides while expected to be present, are in concentrations low enough to not be considered Site ROCs. One discrete location at the Site contained Radium-226, however, it was determined to be due to an isolated piece of equipment deposited there and not due to its presence within natural monazite sands. For this reason, radium was not considered a project ROC.

1.4 Derived Concentration Guideline Level

Historically, the DCGL used by CABRERA at the Great Lakes Naval facility was 1.1 pCi/g above ambient background for ^{232}Th. This was based on the use of the default soil screening value for ^{232}Th published in NUREG-5512, Vol. 3 (NRC, 1999). This value was used at the site between 2000 and 2007 for all characterization and remediation efforts.

In 2007, CABRERA prepared a site-specific DCGL evaluation for the Site, which calculated a ^{232}Th cleanup val;ue of 4 pCi/g, based on a resident gardener scenario, to support the remaining remediation and FSS activities at the Site. This DCGL value, with support from JMC and RASO, was submitted to the NRC Region III and approved for use. All FSS data evaluated herein is therefore compared to this new 4 pCi/g DCGL value. The derivation of

this DCGL is provided in detail in the *Final Site-Specific Derived Concentration Guideline Level* (CABRERA, 2007), provided in Appendix G.

1.5 Site Reference Coordinate System

The Site reference coordinate system was designed to ensure sample and measurement locations are spatially identified such that each location is reliably reproducible. The basic unit of the coordinate system is meters. SU grids, Site boundaries, and other survey reference points are described by northing and easting coordinates, in meters, tied to the Illinois East State Plane Coordinate System, North American Datum 1983. References in this report to specific locations are of the form "xxx,xxx.x north, yyy,yyy.y east"; where xxx,xxx.x is the northing coordinate in meters and yyy,yyy.y is the easting coordinate in meters.

2.0 CHARACTERIZATION ACTIVITIES

Characterization was performed, prior to remedial activities, within SUs 3, 4, 5, 17, and 18. SU 2 was unable to be characterized due to the presence of a soil stockpile from previous remedial activities with an approximate volume of 875 cy (referred to later as SUs 17 and 18). Characterization activities consisted of GWS, systematic and biased soil sampling, DGL, and on-site gamma spectroscopy analysis. These surveys aserved to augment those previously collected by CABRERA between 2000 and 2004.

2.1 Gamma Walkover Surveys

As part of the characterization activities for Site 18, GWSs were performed over 100% of the accessible surfaces in each of the SUs. The purpose of the GWSs was to identify areas of elevated surface radioactivity. GWSs were performed using a Trimble XR-Pro and TSC 1 global positioning system (GPS) coupled to a Ludlum Model 44-10 2x2 NaI detector with a Ludlum Model 2221 scaler/ratemeter. All GPS positional data collection was done in real time using differential correction provided by either the satellite signal or the Coast Guard beacon signal. The GWS was performed following MARSSIM protocol, by walking straight parallel lines at a rate of approximately 0.5 meters per second (m/s) while moving the detector in a serpentine motion of approximately 1 meter wide and a consistent distance of approximately 2-4 inches above the ground surface. GWS data in gross counts per minute (cpm) from the scaler/ratemeter was automatically logged into the GPS unit at a rate of once per second. All GPS data was collected in U.S. State Plane Feet, Illinois East State Plane Coordinate System, North American Datum 1983. Upon survey completion, the data was downloaded from the GPS unit and sent to a data processing specialist for import into a geographical information system for processing and imaging.

2.2 Soil Sampling

Systematic surface and subsurface soil samples were taken at locations determined by a random start triangular grid-sampling pattern, in accordance with MARSSIM protocols. Samples were collected using a direct-push rig, e.g., Geoprobe®, to a total depth of 4 fett below ground surface, resulting in four 1-foot increments for each location. The entire core was inspected by a field geologist, who characterized the soil types and determined the increment level of the native soil.

A minimum of two intervals were analyzed from each core; the top-foot increment and a subsurface increment with the highest DGL reading. Each was prepared and analyzed in the CABRERA on-site gamma spectroscopy laboratory using a high purity germanium (HPGe) detector system. Those samples which exceeded the Site DCGL of 4 pCi/g were used to identify areas which required remediation.

3.0 REMEDIATION ACTIVITIES

Based on the results of surface and subsurface characterization soil samples, it was determined that small areas of soil in SUs 3, 4, 5, and 18 would exceed the new Site clean-up criterion. Historical records indicated that some soils within SU 1 would also require excavation and offsite disposal. GWS and on-site gamma spectroscopy analysis of excavation support samples were used to delineate the specific areas where soil was to be removed.

3.1 SU 1 Remediation Activities

Previous historical records indicated that a "sound-powered phone jack" containing ^{226}Ra had been buried in the vicinity of SU 1. While no coordinates existed, there was a benchmark (a cone) that delineated the location of the source. This position was supported by 2 x 2 NaI counts upwards of 150,000 cpm and physical evidence such as broken glass and metal. During excavation activities, 6" lifts with an area of 3 meters x 3 meters square were executed and soil was hand dug in the immediate vicinity of the jack. The remediated soils were live-loaded into a SuperSack lift-liner with an excavator. An investigation sample (SU1-IN1) was taken of the remeditated soil, which showed a ^{226}Ra.concentration of 29.8 pCi/g. Biased samples were also taken around the periphery of the localized excavation area to ensure the remaining soils all met the Site release criteria.

3.2 SU 2 Remediation Activities

No remediation of soils in SU 2 were required aside from the relocation of the soil stockpile located atop of the SU 2 soils..

3.3 SU 3, 4, and 5 Remediation Activities

Characterization surveys prior to and including 2007 characterization sampling identified the areas requiring remediation within SUs 3, 4, and 5. Excavation areas were bounded using the coordinates of soil samples with results exceeding the DCGL. The areas were then systematically excavated until the remedial support samples all demonstrated results under 4 pCi/g.

3.4 SU 17 and 18 Remediation Activities

The soil stockpile generated during 2004 remediation activities was temporarily staged within the boundaries of what was considered SU 2. As part of the 2007 remediation and FSS activities, this stockpile was initially leveled to 2 feet high using an excavator and front-end loader to allow two consecutive 'lifts' to be performed. The first 1 foot layer of the stockpile was surveyed as SU 17 with a 100% GWS and 14 systematic soil samples collected. Successful survey and removal of the first lift would lead to the initiation of the second lift's activities.

The GWS results for SU 17 showed an isolated area toward the center of the unit. Three biased samples were collected in this area, but all were shown to be below the DGCL (max ^{232}Th concentration of 2.18 pCi/g).

The GWS results for SU 18 showed a similar hotspot in the same isolated area as SU 17. The levels of the GWS and the results of the pre-remediation biased sample (SU18-B32, 32 pCi/g) indicated this area required remedial action. Approximnately 10 cy of soil was removed from this area and loaded into a SuperSack lift-liner. The remainder of SU 18 was removed as clean and set aside for use as backfill upon successful completion of FSS activities.

3.5 Waste Packaging

All areas were remediated using a 330 Caterpillar excavator and a 924 Caterpillar front-end loader. The soils were excavated from each area and transferred directly into the bucket of the loader for transport to a central lift-liner packaging area. The lifting frame was placed in the central island of Vermont Court, with lift-liners placed into the frame as needed. The loader would bring excavated soils to the lifting frame location and load the liners. Once the liner was filled to capacity, it was zipped closed and lifted out of the frame using a 24,000-lb forklift. The filled bags were temporarily staged at the southern end of Vermont Court, on top of geotextile fabric. It was determined during the course of excavation activities that a single lift-liner could hold approximately 8.5 tons of excavated soil.

3.6 Waste Shipment and Disposal

Soils exceeding the DCGL of 4 pCi/g ^{232}Th were packaged in 10 cubic-yard (CY) soft-sided containers, (i.e., super-sacks). Each super-sack was found to hold approximately 8.5 tons of soil. The super-sacks were temporarily stored on-site, then transported to a nearby railhead in Kenosha, Wisconsin, where the containers were transloaded into gondola railcars. The wastes were profiled for disposal at the U.S. Ecology facility in Grandview, Idaho as unimportant quantities of source material (less than 0.05% by weight, or equivalent to 55 pCi/g of ^{232}Th). The highest concentration of ^{232}Th identified in these soils was 32 pCi/g.

The soils shipped during 2007 were a combination of those remediated from the FMSSA as well as a portion of the soils remediated from within the PPV area. Since more remedial activities are scheduled within the PPV area in 2008, a full discussion of the waste shipment and disposal operations will not be included here. This discussion, complete with copies of all waste manifests, will be provided with the PPV Final Closure Report.

4.0 FINAL STATUS SURVEY ACTIVITIES

An FSS was conducted after the remedial activities were complete. All activities were performed in accordance with the *Public Private Venture Area Remediation Addendum* to *Work Plan for the Remediation of the Recreation and Center Tank Areas and Site Wide Final Status Survey* (CABRERA, 2007) which was developed using MARSSIM guidelines.

4.1 Gamma Walkover Survey

As part of the FSS activities for the Site, GWSs were performed over 100% of each of the SUs and after remediation was complete, GWS was performed over the excavation areas within SUs 3, 4, 5, 17, and 18. Prior GWS from characterizations were also used if the area was determined to be initially clean. In areas where the post-remediation GWS overlapped the pre-remediation data, the two data sets were merged with the post-remediation data given preference.

4.2 Systematic Surface Soil Sampling

Surface soil samples (to one foot) were collected in each of the SUs. The minimum number of systematic soil sample locations required in each of the SUs was established using MARSSIM guidance. Surface soil samples were collected in the SUs using a systematic triangular grid pattern with a random start point. Grid spacing was calculated for each SU based on the area of the SU. Random start point coordinates were established using a computer-generated random coordinate set. Systematic sample locations are shown in Figure 4 and the FSS results are presented in Appendix C. The chain of custody was maintained for the collected soil and the sample was transferred to the on-site laboratory.

4.3 Biased Soil Sampling

Surface soil samples were collected at biased locations to identify potential areas of elevated radioactivity. Biased surface soil samples were collected within the excavation areas and at previously remediated areas.

4.4 On-site Gamma Spectroscopy Laboratory

Following sample collection and logging, they were prepared for analysis by heating to dryness in a conventional oven. Once dry, the soil was sieved and ground to a consistent particle size to provide a homogeneous sample. All sieving and grinding operations were performed(inside a hood equipped with a high-efficiency particulate air (HEPA) filtration system. The completed sample was then packaged for counting in a 1-liter Marinelli container.

CABRERA performed on-site gamma spectroscopy sample analyses on soil all samples utilizing a coaxial HPGe detector. Prior to the performance of project sample analyses, the detector was calibrated using a mixed gamma standard traceable to the National Institute of Standards Technology (NIST).

The gamma spectroscopy system was operated by a trained operator in accordance with CABRERA'S Standard Operating Procedures. The operator performed spectral analysis during each measurement, which encompassed the evaluation of spectra for problems such as peak shift, high dead-time and other potential inconsistencies in spectral structure. A qualified Health Physicist reviewed the integrity of the sample analysis results for each sample prior to submittal of final results to RASO for approval. This review encompassed the analysis of sample results for spectral energy shift, agreement between progeny activities assumed to be in secular equilibrium, the presence of potentially unidentified radionuclides, as well as other potential inconsistencies. Sample count times were determined to be fifteen minutes, in order to accomplish the sufficient minimum detectable concentrations (MDCs) to meet applicable Site clean up criterion.

CABRERA utilized a radionuclide library consisting of radionuclides present in natural background and ^{137}Cs, from global nuclear weapons testing fallout, to analyze the gamma spectral data. Radionuclide gamma/x-ray energies and yields were extracted from the National Nuclear Data Center NUDAT nuclear data database (version dated 22 August 2002). CABRERA gamma spectroscopy data reported for Actinium-228 (^{228}Ac) was used to represent ^{232}Th activity concentrations under the assumption of secular equilibrium. Thus, references to ^{232}Th activity concentrations herein are based on the gamma spectroscopy results of ^{228}Ac. The ^{228}Ac gamma lines used to infer ^{232}Th activity concentration are 911.2 kiloelectron volts (keV) at 25.8% yield, 969.0 keV at 15.8% yield, and 338.3 keV at 11.3% yield, and several additional lower yielding gamma lines. The Onsite Gamma Spectroscopy Laboratory raw results are included as Appendix C.

Discussion of On-site Lab Quality Assurance and Quality Control (QA/QC) results are presented in Section 6.0, with QC data included as Appendix D.

5.0 FSS RESULTS

Evaluation of the FSS data compiled within each SU was performed using the MARSSIM Sign Test. The Sign Test was chosen since the levels of natural ^{232}Th in Site soils are at levels considered to be negligible in comparison to the new $DCGL_w$ of 4 pCi/g. Therefore, a background reference area was not required for the MARSSIM FSS evaluation of the data. The results of each SU sign test is summarized below in Table 5-1 with Sign Test Worksheets for each SU also included in Appendix A. Plots of the GWS results from within each SU are provided in the Figures section of this report.

5.1 SU 1

The FSS evaluation of SU 1 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 21 systematic samples. Since no contoured Z-score value was greater than 3.0, no bias samples were necessary in SU 1. The ^{232}Th concentrations of the systematic samples ranged from 0.05 to 0.99 pCi/g, averaging 0.47 pCi/g with a standard deviation of 0.25 pCi/g. All FSS sample results for SU 1 were below the Site action level for ^{232}Th of 4 pCi/g. This SU passed the release criteria and is thereby suitable for unrestricted release.

5.2 SU 2

The FSS evaluation of SU 2 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 20 systematic samples. Since no contoured Z-score value was greater than 3.0, no bias samples were necessary in SU 2. The ^{232}Th concentrations of the systematic samples ranged from 0.18 to 1.37 pCi/g, averaging 0.81 pCi/g with a standard deviation of 0.37 pCi/g. All FSS sample results for SU 2 were below the Site action level for ^{232}Th of 4 pCi/g. This SU passed the release criteria and is thereby suitable for unrestricted release.

5.3 SU 3

The FSS evaluation of SU 3 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 18 systematic samples and 5 bias samples. The ^{232}Th concentrations of the systematic samples ranged from 0.56 to 1.70 pCi/g, averaging 0.92 with a standard deviation of 0.32. The ^{232}Th concentrations of the bias samples ranged from 0.67 to 3.90 pCi/g. All FSS sample results for SU 3 were below the Site action level for ^{232}Th of 4 pCi/g. This SU passed the release criteria and is thereby suitable for unrestricted release.

5.4 SU 4

The FSS evaluation of SU 4 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 21 systematic samples and 2 bias samples. The ^{232}Th concentrations of the systematic samples ranged from 0.27 to 1.61 pCi/g, averaging 0.75 pCi/g with a standard deviation of 0.30 pCi/g. The ^{232}Th concentrations of the bias samples ranged from 0.82 to 1.08 pCi/g. All FSS sample results for SU 4 were below the Site action level for ^{232}Th of 4 pCi/g. This SU passed the release criteria and is thereby suitable for unrestricted release.

5.5 SU 5

The FSS evaluation of SU 5 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 21 systematic samples and 3 bias samples. The ^{232}Th concentrations of the systematic samples ranged from 0.17 to 1.26 pCi/g, averaging 0.79 pCi/g with a standard deviation of 0.28 pCi/g. The ^{232}Th concentrations of the bias samples ranged from 0.98 to 2.39 pCi/g. All FSS sample results for SU 5 were below the Site action level for ^{232}Th of 4 pCi/g. This SU passed the release criteria and is thereby suitable for unrestricted release.

5.6 SU 17

The FSS evaluation of SU 17 encompassed the performance of a GWS and the collection and gamma spectroscopy analysis of 14 systematic samples and 3 bias samples (SU17-B29, B30, and B31). The ^{232}Th concentrations of the systematic samples ranged from 1.01 to 1.61 pCi/g, averaging 1.36 pCi/g with a standard deviation of 0.17 pCi/g. The ^{232}Th concentrations of the bias samples ranged from 1.25 to 2.18 pCi/g, all below the Site DCGL for ^{232}Th of 4 pCi/g. This lift was removed completely as meeting the release criteria and is thereby suitable for restricted reuse as backfill on-site.

5.7 SU 18

The FSS evaluation of SU 18 included the performance of a GWS and the collection and gamma spectroscopy analysis of 14 systematic samples and one bias sample post-remediation (SU18-B33). The ^{232}Th concentrations of the systematic samples ranged from 1.01 to 1.93 pCi/g, averaging 1.25 pCi/g with a standard deviation of 0.25 pCi/g. The ^{232}Th concentration of the bias sample was 1.43 pCi/g. All FSS sample results for SU 18 were below the Site action level for ^{232}Th of 4 pCi/g. This lift was removed completely as meeting the release criteria and is thereby suitable for restricted reuse as backfill on-site.

Table 5-1: FSS Summary Statistics

Survey Unit Statistic	Survey Unit						
	SU-1	SU-2	SU-3	SU-4	SU-5	SU-17	SU-18
Sample Size, n	21	20	18	21	21	14[1]	14[1]
Prospective Assumed Sigma	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Sample Average	0.47	0.81	0.92	0.75	0.79	1.36	1.25
Sample Maximum	0.99	1.37	1.70	1.61	1.26	1.61	1.93
Sample Minimum	0.05	0.18	0.56	0.27	0.17	1.01	1.01
Sample Retrospective Sigma	0.25	0.37	0.32	0.30	0.28	0.17	0.25
Bias Sample Maximum	N/A	N/A	3.90	1.08	2.39	2.18	1.53[2]
Bias Sample Minimum	N/A	N/A	0.67	0.82	0.98	1.25	1.53[2]
Sign Test Results (Pass or Fail)	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Notes:
1. The number of samples was reduced for SU-17 & SU-18 as these were the soil stockpiles from previous remediation efforts.
2. Only one bias sample was collected for SU 18

check on rationale

6.0 SITE RESTORATION

Upon completion of all FSS activities, a Backfill Request Authorization Letter was submitted to RASO for approval. Upon concurrence from RASO that all remediation and survey objectives had been met, each open excavation was back-filled with borrow-source gravel back to grade level. In areas where additional investigations are planned for 2008, geotextile fabric was used to demarcate the boundary of where successful remediation and FSS had been completed.

Copies of each Backfill Request Letter are provided in Appendix F. does this include OK ppm particles ?? NO!!

7.0 QUALITY ASSURANCE / QUALITY CONTROL

7.1 CABRERA On-site Laboratory Quality Control Results

7.1.1 System Calibration

The CABRERA Laboratory HPGe detector was calibrated with a NIST traceable multi-line gamma marinelli standard prior to the performance of project sample analyses. The marinelli standard used for the system efficiency calibration consisted of a geometry identical to those used for sample analyses, with a density approximate to the average density of the project samples.

7.1.2 Daily Quality Control Checks

Cadmium-109 (^{109}Cd) and Cobalt-60 (^{60}Co) sources were used to perform daily Quality Control (QC) activities. Analysis of the QC standards was performed each day sample analyses were conducted in order to evaluate the detector performance against established gamma spectroscopy QC criteria for the project. The QC criteria consisted of detector resolution, using measurement of Full Width at Half Maximum, peak energy measurements, and decay corrected activity concentration measurements. Each criterion was evaluated for Cadmium-109 (^{109}Cd) at 88.1 keV and Cobalt-60 (^{60}Co) at 1332.5 keV. Daily QC results passed comparison criteria for each day that project sample analyses were performed. Results for all daily QC checks are provided in Appendix D.

The Quality Control Charts show a tendency toward the end of the project (last week of November) for a decrease in the efficiency approaching the action level. However, the results were still within acceptable limits so the resulting data was accepted without qualification.

7.1.3 Laboratory Blanks

The CABRERA Laboratory performed blank analyses to test analytical accuracy and to estimate the extent of bias in the measurements. CABRERA prepared blanks consisting of a media similar to the samples and free of radiological contamination. Blank analyses were performed weekly in accordance with the laboratory's written procedures. Blank sample analysis results for ^{232}Th were all less than the analytical MDC, indicating that laboratory sample processing and handling did not introduce a positive bias in the sample results.

7.1.4 Laboratory Replicate Sample Analyses

CABRERA performed replicate analyses for 5% of the samples analyzed in the CABRERA Laboratory. Replicate analyses entailed repeating the analysis of a previously analyzed sample and comparing the results statistically using a Z-Replicate method as recommended in Chapter 18 of the Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) manual. Z_{Rep} evaluates a sample result against a duplicate (or QA sample), including the stated uncertainties of each sample. The formula for Z_{Rep} is:

$$Z_{\text{Re plicate}} = \frac{Sample - Duplicate}{\sqrt{\sigma^2_{Sample} + \sigma^2_{Duplicate}}}$$

check marking for sample,

Where:

Sample	=	first sample value (original),
Duplicate	=	second sample value (duplicate),
Sample	=	total propagated measurement uncertainty of the sample, and
Duplicate	=	total propagated measurement uncertainty of the duplicate

The calculated Z_{Rep} results should be compared to a performance criteria of ±2.57. Duplicate analyses that result in a Z_{Rep} outside of ±2.57 should be investigated for possible discrepancies in analytical precision or sources of disagreement within the following assumptions:

- The sample measurement and duplicate or replicate measurement are of the same normally distributed population;
- The standard deviations represent the true standard deviation of the measured population

Results of the CABRERA on-site Laboratory replicate evaluations for are provided in Table 7-1. All on-site laboratory replicate samples passed the requisite Z-score evaluation.

7.1.5 Off-site Laboratory Cross-Check Duplicate Analyses

Test America performed cross-check gamma spectroscopy analyses on 10% of the soil samples collected and analyzed by the CABRERA Laboratory. Results of both laboratories were compared using the Z-Replicate (Z_{Rep}) method as described in Section 7.1.4. The results of the laboratory comparisons for all SUs are provided in Table 7-2 . Test America laboratory data packages are included as Appendix E.

Of the samples evaluated during the off-site cross-check 10 (or 40%) were found to have a Z_{Rep} greater than the tolerance level of 2.57. It was later discovered that Test America utilized only 350-g aliquot samples (out of the ~1500g provided) to perform their analyses. We feel this sub-sampling introduced additional sample bias caused by heterogeneity within the total volume. Depending on whether the off-site lab sampled either localized "pockets" of contamination (or not), their results may have been preferentially biased versus the aggregate average reported via the entire sample mass in the on-site laboratory.

It should be noted that of these 10 failures, five had Z_{Rep} values between 2.65 and 3.27, with very low relative ^{232}Th concentrations (< 2 pCi/g). These samples displayed a distribution of both positive and negative results, indicating only slight impact of the heterogeneity. The remaining five had higher variation, but also higher concentrations of ^{232}Th, which likely are correlated with the relative impact of the heterogeneity. Although this stated failure rate is abnormally high, CABRERA feels that it is primarily due to preparation bias and should not attributable to the accuracy of the CABRERA Laboratory. For this reason, we feel no additional data qualification is warranted.

Table 7-1: Summary of On-site Laboratory QA Replicate Sample Comparison

Original Sample Result			Replicate Sample Results			Z-Score	Z-Score Pass/Fail (<2.57)
Sample ID	Result	Uncert	Sample ID	Result	Uncert		
SU1-8-PR	ND	--	SU1-8-PR Dup	ND	--	N/A	N/A
SU1-13-PR	ND	--	SU1-13-PR Dup	3.46E-01	0.09	N/A	N/A
SU2-26-PR	7.36E-01	0.13	SU2-26-PR Dup	7.47E-01	0.13	0.06	Pass
SU2-35-PR	9.62E-01	0.11	SU2-35-PR Dup	8.87E-01	0.12	0.45	Pass
SU3-52-1	1.12E+00	0.17	SU3-52-1 Dup	9.79E-01	0.16	0.61	Pass
SU3-58-1	6.22E-01	0.11	SU3-58-1 Dup	5.19E-01	0.13	0.59	Pass
SU4-71-1	8.13E-01	0.16	SU4-71-1 Dup	6.32E-01	0.15	0.84	Pass
SU4-75-1	ND	--	SU4-75-1 Dup	ND	--	N/A	N/A
SU4-79-1	1.05E+00	0.15	SU4-79-1 Dup	1.01E+00	0.15	0.18	Pass
SU5-85-1	7.48E-01	0.18	SU5-85-1 Dup	ND	--	N/A	N/A
SU5-91-3	6.51E-01	0.13	SU5-91-3 Dup	7.29E-01	0.13	0.42	Pass
SU5-93-2	1.02E+00	0.17	SU5-93-2 Dup	9.93E-01	0.16	0.14	Pass
SU5-101-2	8.51E-01	0.15	SU5-101-2 Dup	8.34E-01	0.14	0.08	Pass
SU5-104-1	1.18E+00	0.17	SU5-104-1 Dup	1.14E+00	0.18	0.16	Pass
SU5-105-1	5.83E-01	0.16	SU5-105-1 Dup	5.20E-01	0.15	0.30	Pass
SU5B-052 PR	9.83E-01	0.13	SU5B-052 PR Dup	9.59E-01	0.14	0.13	Pass
SU17-05-1	1.18E+00	0.13	SU17-05-1 Dup	1.18E+00	0.15	0.01	Pass
SU17-10-1	1.61E+00	0.18	SU17-10-1-Dup	1.30E+00	0.17	1.26	Pass
SU17-14-1	1.01E+00	0.13	SU17-14-1-Dup	9.96E-01	0.14	0.07	Pass
SU17-B29-1	1.25E+00	0.15	SU17-B29-1 Dup	1.34E+00	0.14	0.44	Pass
SU18-07-1	1.07E+00	0.16	SU18-07-1 Dup	1.03E+00	0.16	0.18	Pass
SU18-11-1	1.01E+00	0.15	SU18-11-1 Dup	1.15E+00	0.15	0.68	Pass

Note: ND = Not Detected

Table 7-2: Comparison of On-site Lab Results with Off-site Laboratory QA Results

Sample ID	Off-site Lab Sample Results		On-site Lab Sample Results		Z-Score	Z-Score Pass/Fail (<2.57)
	Result	Uncert	Result	Uncert		
SU1-14-PR	0.80	0.15	0.99	0.08	1.11	Pass
SU2-25-PR	0.98	0.11	1.29	0.07	2.36	Pass
SU2-31-PR	1.00	0.13	0.98	0.06	0.14	Pass
SU3-43-1	1.48	0.15	1.70	0.12	1.13	Pass
SU3-52-2	1.10	0.16	1.36	0.10	1.39	Pass
SU3-55-1	1.20	0.12	1.59	0.08	2.73	***Fail***
SU3B-049 PR	4.60	0.26	3.90	0.11	2.53	Pass
SU4-64-2	1.00	0.11	1.63	0.10	4.32	***Fail***
SU4-65-1	0.63	0.10	1.11	0.09	3.57	***Fail***
SU4-67-2	1.11	0.14	1.03	0.08	0.50	Pass
SU4-76-1	1.13	0.13	1.61	0.09	3.05	Fail
SU4-79-3	1.07	0.12	1.24	0.08	1.20	Pass
SU5-88-1	0.74	0.12	1.15	0.08	2.83	***Fail***
SU5-93-1	1.12	0.18	1.13	0.10	0.06	Pass
SU5-93-2	1.11	0.16	1.02	0.09	0.48	Pass
SU5-103-1	1.41	0.13	1.10	0.09	1.97	Pass
SU5B-054 PR	3.04	0.22	2.39	0.11	2.65	***Fail***
SU17-07-1	1.41	0.14	1.58	0.09	1.04	Pass
SU17-10-1	1.47	0.17	1.61	0.09	0.75	Pass
SU17-12-1	1.68	0.19	1.60	0.09	0.40	Pass
SU17-B30-1	4.16	0.32	2.18	0.09	5.98	***Fail***
SU18-04-1	1.08	0.15	1.59	0.09	2.95	***Fail***
SU18-06-1	2.62	0.20	1.93	0.08	3.27	***Fail***
SU18-B32-1	40.10	1.45	32.18	0.35	5.31	***Fail***
SU18-B33-1	2.05	0.24	1.53	0.16	1.79	Pass

Note: All results in pCi/g

7.2 Field Instrumentation QC Results

Data collection activities were performed in accordance with written procedures and/or protocols in order to ensure consistent, repeatable results. The Field Site Manager ensured that individuals were appropriately trained to use project instrumentation and other equipment, and that instrumentation met the required detection sensitivities.

7.2.1 Calibration Requirements

Radiological instruments were used to scan soil surfaces, equipment, personnel, and clothing for radiological contamination. Current calibration/maintenance records were kept on-site for review and inspection (included in Appendix B). The records include, at a minimum, the following:

- equipment identification (model and serial number)
- manufacturer
- date of last calibration
- calibration due date

Instrumentation was maintained and calibrated to manufacturers' specifications to ensure that required traceability, sensitivity, accuracy and precision of the equipment/instruments were maintained. Instruments were calibrated at a facility possessing appropriate NRC and/or Agreement State licenses for performing calibrations using NIST traceable sources. Copies of these calibration certificates are included in Appendix B.

7.2.2 QC Source and Background Checks

Prior to daily use, instruments were QC checked by comparing the instruments' response to a designated radiation source and to ambient background. Prior to the commencement of field operations a reference location was used for performance of these checks. Background checks were performed in an identical fashion with the source removed. At the start of the field activities, this procedure was repeated ten times to establish an average instrument response.

During QC checks, instruments used to obtain qualitative radiological data were inspected for physical damage, current calibration, and erroneous readings in accordance with applicable procedures and protocols.

Instrument response to the designated QC check source was evaluated against the average established at the start of the field activities. Performance criteria of ± 20% of this average were used as an investigation action level for qualitative field instruments, such as a Ludlum 44-20 3x3 NaI, a 44-9 Geiger-Muller.(GM) detector, and a Ludlum 43-93 dual-phosphor scintillator probe.

Performance criteria of ± 2 sigma as an investigation level and ± 3 sigma as an action level were used for quantitative instruments, or those used for reporting or release data. These

instruments included the stationary smear counting instruments (Ludlum 2929 with a 43-10-1 probes).

During this work evolution, several Ludlum 2929 smear counters were used (see QC sheets in Appendix B). One of the instruments was incorrectly diagnosed as failing due to upward trends in detector count rates, causing daily QC failures. However, it was determined that the increases in background were from increases in monazite sand inventory in stored samples in the room below. These samples were contributing to elevated ambient background dose rate in the counting room. Once this was determined, the samples were moved, and the instruments were restored to a normal operating condition. All QC checks were within the established performance criteria as shown on control charts, included as Appendix B to this report.

7.3 GPS Daily Field Checks

At the start of the field effort the average easting and northing GPS position data was also established. These checks were always performed at the same location and were logged in the GPS unit. During subsequent routine checks, GPS position data was compared to the established averages. All measurements were within the criteria, as shown on control charts included as Appendix B to this report.

8.0 CONCLUSION

CABRERA performed characterization, remediation, and FSS activities within the former FMSSA at the Naval Station Great Lakes in Great Lakes, Illinois. Activities performed included GWS in all accessible areas, direct-push soil coring and DGL to characterize soils at depth, surface and subsurface soil sampling at systematic and biased locations, and on-site preparation and analysis of samples in a field gamma spectroscopy laboratory.

CABRERA also developed and submitted a site-specific DCGL document for the Site to NRC Region 3. This document was approved for use and thus allowed a 4 pCi/g ^{232}Th DCGL to be used for FSS purposes. This value replaced the former NRC SSV as the Site DCGL (1.1 pCi/g ^{232}Th above background).

Remediation of contaminated soils at the Site led to the packaging and shipment of 102 tons of impacted excavated soils to WCS in Andrews, Texas, as unimportant quantities of source material (less than 0.05% by weight, or equivalent to 55 pCi/g of ^{232}Th). Soft-sided 'Super Sack" lift liner containers were used for all waste packaging activities. As these lift-liners were sealed, each was temporarily stored in a central location on-site until they could be transported to a nearby railhead in Kenosha, Wisconsin. The lift-liners were then trans-loaded into gondola railcars and manifested to WCS. The highest concentration of ^{232}Th identified in the remediated soils was 32 pCi/g.

FSS activities consisted of a 100% GWS and sample collection and analysis. Systematic and biased sampling consisted of soil sampling from 120 locations, with samples obtained via a direct-push rig with a macrocore sampler or through surface sampling methods. All FSS sample results were shown to be below the Site DCGL of 4.0 pCi/g. The FSS data indicate that the SUs investigated within the FMSSA are suitable for release for unrestricted use.

9.0 REFERENCES

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(CABRERA, 2004b) *Work Plan for the Characterization of the Recreation and Center Tank Areas and Radiological Remediation and Final Status Survey of the North Fence Area*, Cabrera Services, Inc., August 2004.

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(CABRERA, 2007) *Site Specific Derived Concentration Guideline Level – Final*, Cabrera Services, Inc., May 2007.

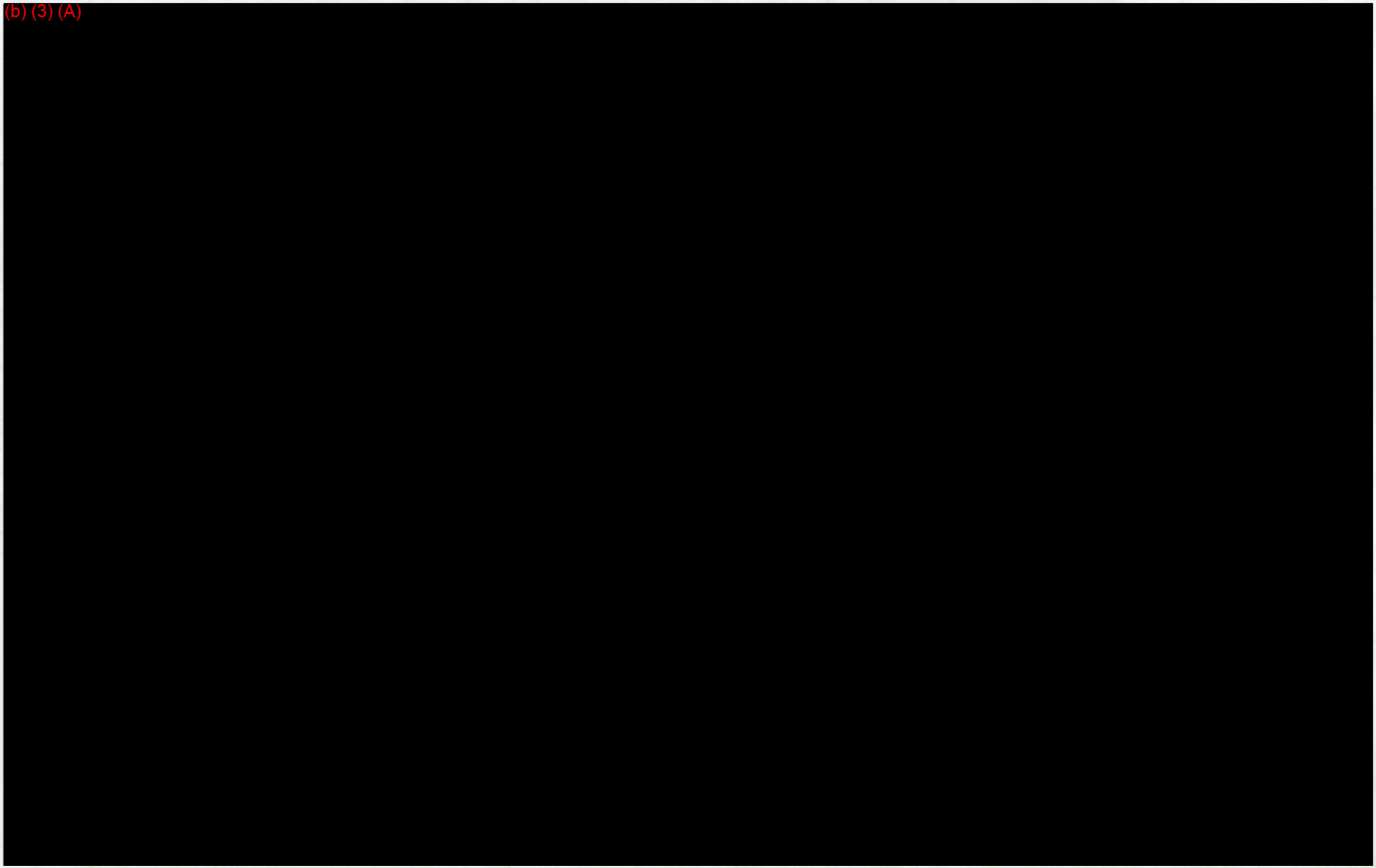
(NRC, 1999) U.S. Nuclear Regulatory Commission, *"Residual Radioactive Contamination from Decommissioning"*, NUREG/CR-5512 Vol. 3, October 1999.

(NRC, 2000) *Multi-Agency Radiation Survey and Site Investigation Manual*, Revision 1, U.S. Nuclear Regulatory Commission, August 2000.

(CABRERA, 2007) *Public Private Venture Area Remediation Addendum* to *Work Plan for the Remediation of the Recreation and Center Tank Areas and Site Wide Final Status Survey* Cabrera Services Inc, May 2007

FIGURES

CABRERA SERVICES RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION	**Site Location Map** **Naval Station Great Lakes**	Date: January 2006 Project #: 05-3060.01 File Name: 05-3060.01_Fg1_Site Prepared By: BP	**Figure 1**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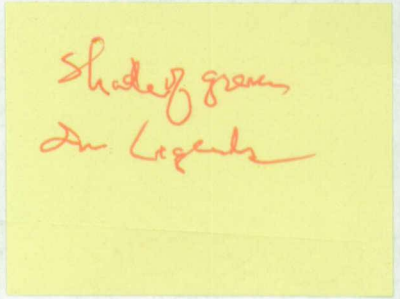

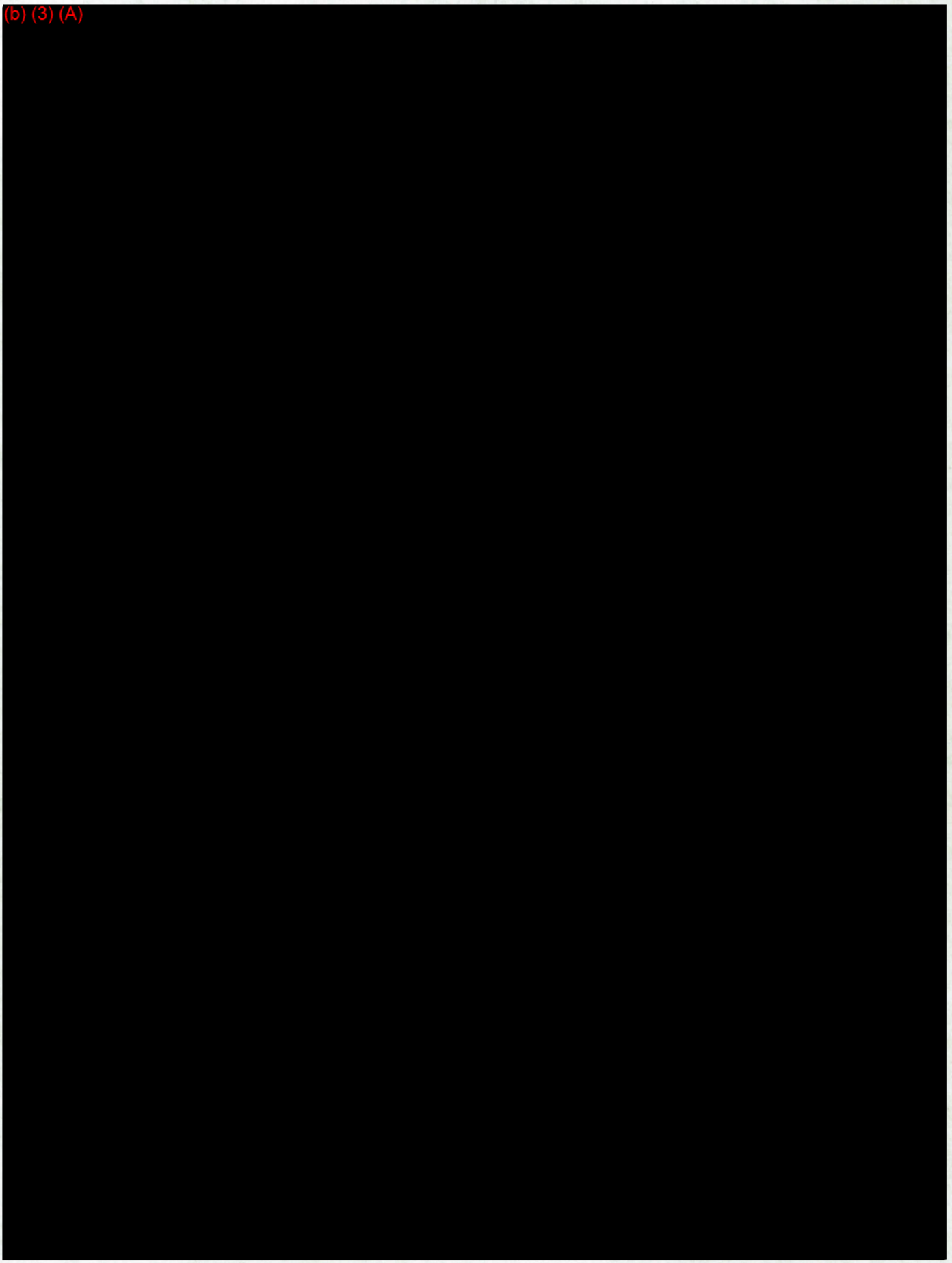
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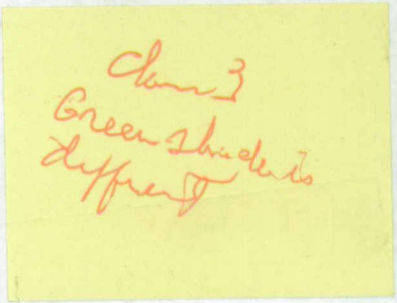
Claim 3
Green Shades to
Different

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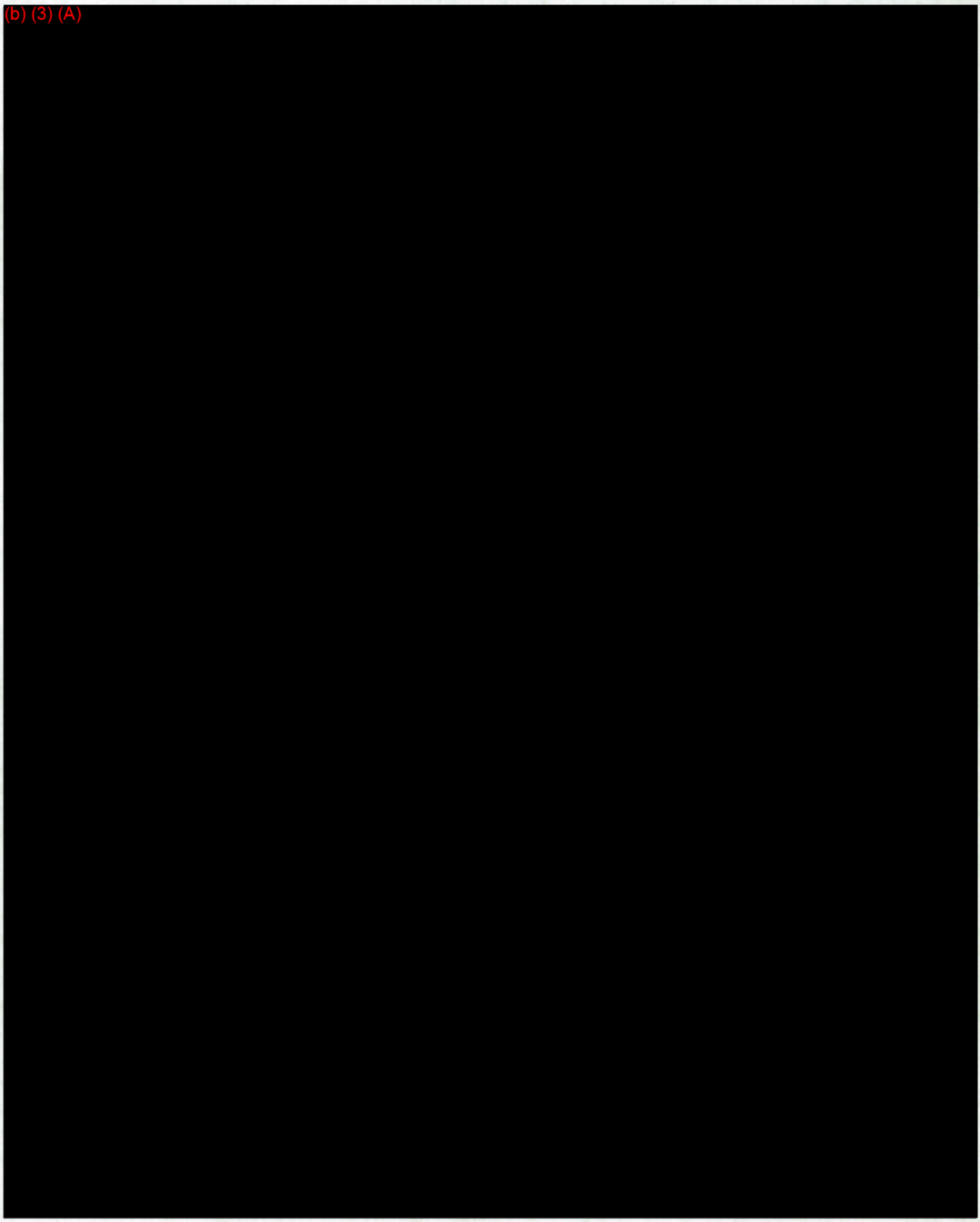

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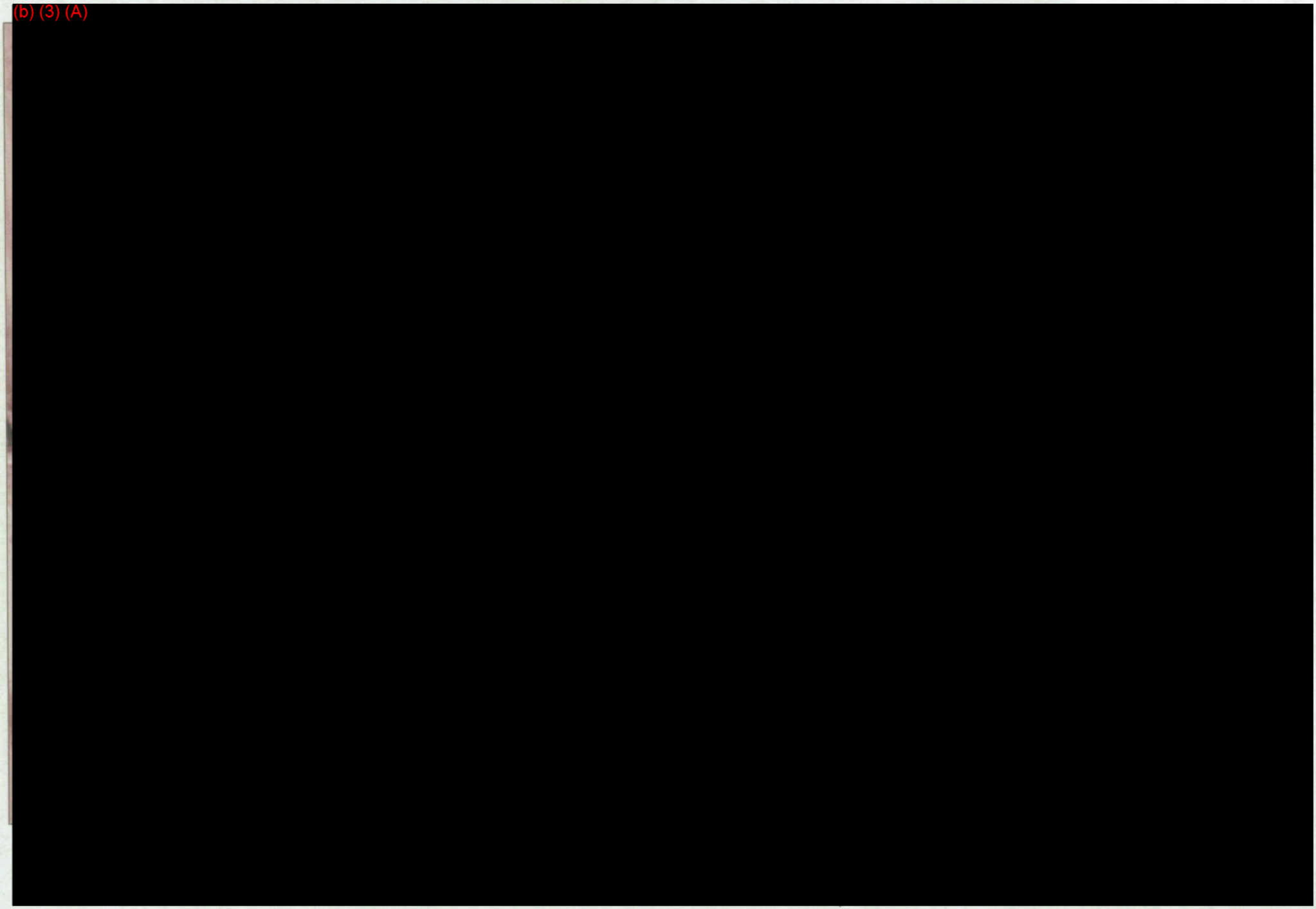

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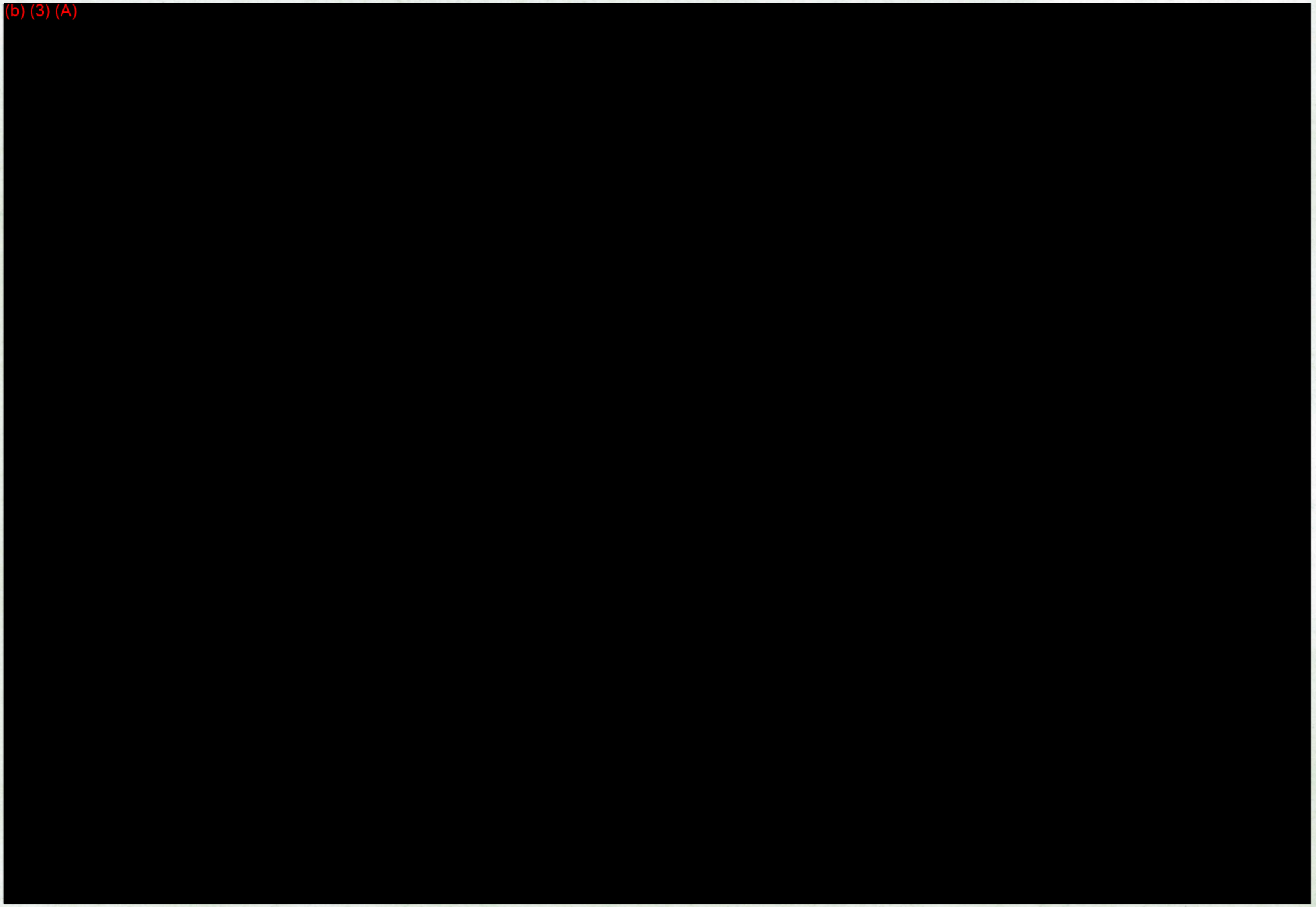

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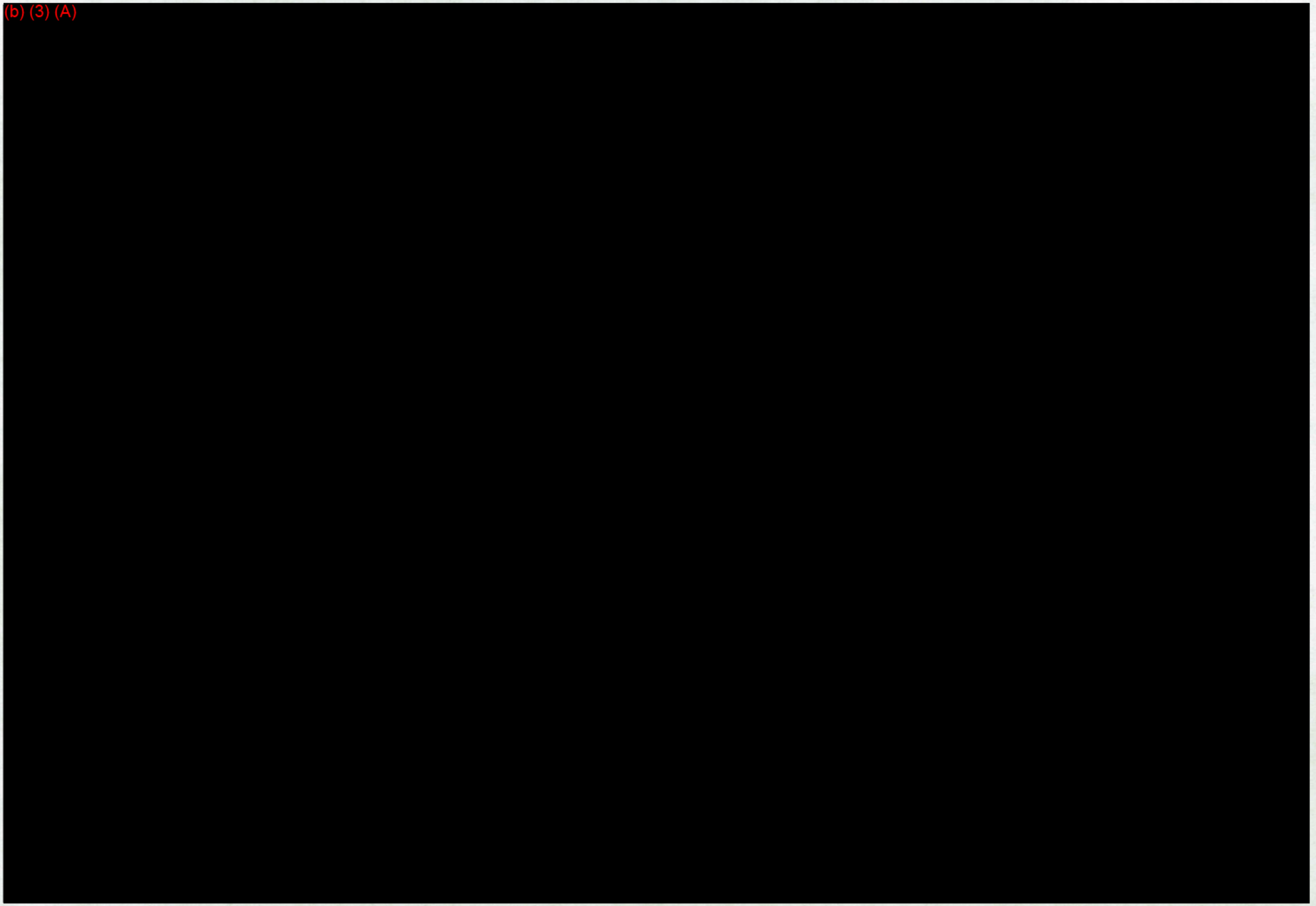
(b) (3) (A)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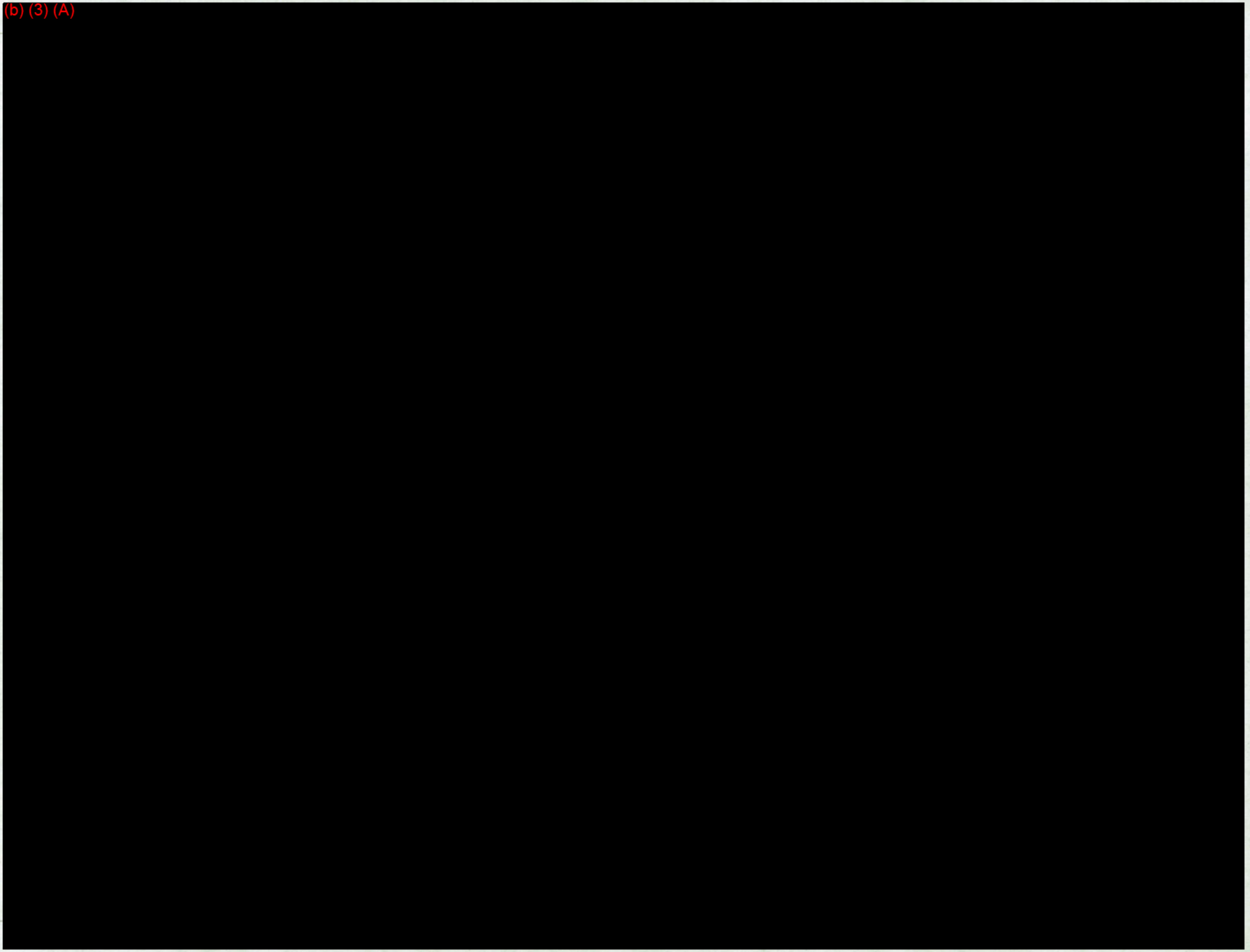

APPENDICES

APPENDIX A

SIGN TEST WORKSHEETS

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	1
MARSSIM Classification	1

Th-232 $DCGL_W$ (pCi/g)	4.0

	Th-232				
Sample ID	**Gross Result (pCi/g)**		**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU1-1-PR	0.36	+/- 0.16	0.34	3.64	1
SU1-2-PR	0.42	+/- 0.11	0.16	3.58	1
SU1-3-PR	0.31	+/- 0.15	0.32	3.69	1
SU1-4-PR	0.05	+/- 0.14	0.30	3.95	1
SU1-5-PR	0.69	+/- 0.12	0.22	3.31	1
SU1-6-PR	0.25	+/- 0.09	0.14	3.75	1
SU1-7-PR	0.69	+/- 0.11	0.19	3.31	1
SU1-8-PR	0.10	+/- 0.09	0.20	3.90	1
SU1-9-PR	0.69	+/- 0.11	0.19	3.31	1
SU1-10-PR	0.38	+/- 0.09	0.16	3.62	1
SU1-11-PR	0.66	+/- 0.12	0.15	3.34	1
SU1-12-PR	0.34	+/- 0.14	0.31	3.66	1
SU1-13-PR	0.36	+/- 0.16	0.34	3.64	1
SU1-14-PR	0.99	+/- 0.16	0.27	3.01	1
SU1-15-PR	0.71	+/- 0.10	0.24	3.29	1
SU1-16-PR	0.53	+/- 0.19	0.40	3.47	1
SU1-17-PR	0.41	+/- 0.09	0.15	3.59	1
SU1-18-PR	0.31	+/- 0.19	0.41	3.69	1
SU1-19-PR	0.82	+/- 0.12	0.21	3.18	1
SU1-20-PR	0.18	+/- 0.13	0.28	3.82	1
SU1-21-PR	0.64	+/- 0.22	0.47	3.36	1

Mean	**0.47**	***Sign Test Statistics***	
Median	**0.41**		
Min	**0.05**	***Sum of Positive Signs***	**21**
Max	**0.99**	***Sign Test Critical Value for N = 21***	**14**
Std Dev (1 σ)	**0.25**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	2
MARSSIM Classification	1

Th-232 $DCGL_W$	4.0

	Th-232					
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU2-22-PR	0.59	+/-	0.11	0.19	3.41	1
SU2-23-PR	0.34	+/-	0.10	0.18	3.66	1
SU2-24-PR	0.32	+/-	0.17	0.37	3.68	1
SU2-25-PR	1.29	+/-	0.14	0.23	2.71	1
SU2-26-PR	0.74	+/-	0.13	0.24	3.26	1
SU2-27-PR	1.10	+/-	0.13	0.18	2.90	1
SU2-28-PR	0.56	+/-	0.10	0.17	3.44	1
SU2-29-PR	0.24	+/-	0.16	0.34	3.76	1
SU2-30-PR	0.79	+/-	0.12	0.21	3.21	1
SU2-31-PR	0.98	+/-	0.12	0.17	3.02	1
SU2-32-PR	1.16	+/-	0.14	0.29	2.84	1
SU2-33-PR	0.18	+/-	0.06	0.15	3.82	1
SU2-34-PR	0.63	+/-	0.10	0.18	3.37	1
SU2-35-PR	0.96	+/-	0.11	0.22	3.04	1
SU2-36-PR	0.95	+/-	0.13	0.20	3.05	1
SU2-37-PR	1.33	+/-	0.15	0.23	2.67	1
SU2-38-PR	0.80	+/-	0.12	0.22	3.20	1
SU2-39-PR	0.68	+/-	0.11	0.23	3.32	1
SU2-40-PR	1.37	+/-	0.22	0.37	2.63	1
SU2-41-PR	1.23	+/-	0.14	0.19	2.77	1

Mean	**0.81**	***Sign Test Statistics***	
Median	**0.80**		
Min	**0.18**	***Sum of Positive Signs***	**20**
Max	**1.37**	***Sign Test Critical Value for N=20***	**14**
Std Dev (1 σ)	**0.37**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	3
MARSSIM Classification	1

Th-232 $DCGL_W$	4.0

	Th-232				
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU3-42-1	0.69	+/-	0.13	0.23	3.31	1
SU3-43-1	1.70	+/-	0.23	0.44	2.30	1
SU3-44-1	1.21	+/-	0.16	0.32	2.79	1
SU3-45-1	1.07	+/-	0.18	0.28	2.93	1
SU3-46-1	0.66	+/-	0.14	0.25	3.34	1
SU3-47-1	0.84	+/-	0.12	0.28	3.16	1
SU3-48-1	1.01	+/-	0.15	0.26	2.99	1
SU3-49-1	0.57	+/-	0.12	0.20	3.43	1
SU3-50-1	0.72	+/-	0.17	0.27	3.28	1
SU3-51-1	0.93	+/-	0.16	0.26	3.07	1
SU3-52-1	1.12	+/-	0.17	0.25	2.88	1
SU3-53-1	0.84	+/-	0.14	0.22	3.16	1
SU3-54-1	0.87	+/-	0.17	0.32	3.13	1
SU3-55-1	1.59	+/-	0.16	0.25	2.41	1
SU3-56-1	0.79	+/-	0.15	0.26	3.21	1
SU3-57-1	0.71	+/-	0.13	0.23	3.29	1
SU3-58-1	0.62	+/-	0.11	0.22	3.38	1
SU3-59-1	0.56	+/-	0.13	0.22	3.44	1

Mean	**0.92**	***Sign Test Statistics***	
Median	**0.84**		
Min	**0.56**	***Sum of Positive Signs***	**18**
Max	**1.70**	***Sign Test Critical Value for N=18***	**12**
Std Dev (1 σ)	**0.32**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	4
MARSSIM Classification	1

Th-232 $DCGL_W$	4.0

	Th-232					
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU4-62-1	0.54	+/-	0.15	0.28	3.46	1
SU4-64-1	0.96	+/-	0.14	0.24	3.04	1
SU4-65-1	1.11	+/-	0.18	0.25	2.89	1
SU4-66-1	0.61	+/-	0.13	0.23	3.39	1
SU4-67-1	0.94	+/-	0.15	0.25	3.06	1
SU4-68-1	0.68	+/-	0.16	0.26	3.32	1
SU4-69-1	0.27	+/-	0.12	0.21	3.73	1
SU4-70-1	0.99	+/-	0.17	0.31	3.01	1
SU4-71-1	0.81	+/-	0.16	0.30	3.19	1
SU4-72-1	0.92	+/-	0.15	0.25	3.08	1
SU4-73-1	0.78	+/-	0.17	0.33	3.22	1
SU4-74-1	0.59	+/-	0.14	0.28	3.41	1
SU4-75-1	0.67	+/-	0.00	0.66	3.33	1
SU4-76-1	1.61	+/-	0.17	0.28	2.39	1
SU4-77-1	0.68	+/-	0.13	0.21	3.32	1
SU4-78-1	0.66	+/-	0.15	0.31	3.34	1
SU4-79-1	1.05	+/-	0.15	0.25	2.95	1
SU4-80-1	0.42	+/-	0.00	0.48	3.58	1
SU4-81-1	0.45	+/-	0.15	0.26	3.55	1
SU4-82-1	0.69	+/-	0.12	0.22	3.31	1
SU4-83-1	0.34	+/-	0.13	0.22	3.66	1

Mean	**0.75**	***Sign Test Statistics***	
Median	**0.68**		
Min	**0.27**	***Sum of Positive Signs***	**21**
Max	**1.61**	***Sign Test Critical Value for N=21***	**14**
Std Dev (1 σ)	**0.30**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	5
MARSSIM Classification	1

Th-232 $DCGL_W$	4.0

	Th-232				
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU5-84-1	0.78	+/-	0.12	0.22	3.22	1
SU5-85-1	0.75	+/-	0.18	0.23	3.25	1
SU5-86-1	0.66	+/-	0.16	0.25	3.34	1
SU5-87-1	0.84	+/-	0.15	0.23	3.16	1
SU5-88-1	1.15	+/-	0.16	0.29	2.85	1
SU5-89-1	0.55	+/-	0.12	0.23	3.45	1
SU5-90-1	0.58	+/-	0.16	0.31	3.42	1
SU5-91-1	0.73	+/-	0.14	0.24	3.27	1
SU5-92-1	0.17	+/-	0.00	0.33	3.83	1
SU5-93-1	1.13	+/-	0.19	0.35	2.87	1
SU5-94-1	0.92	+/-	0.16	0.28	3.08	1
SU5-95-1	0.94	+/-	0.18	0.30	3.06	1
SU5-96-1	0.98	+/-	0.18	0.36	3.02	1
SU5-97-1	0.46	+/-	0.00	0.51	3.54	1
SU5-98-1	0.63	+/-	0.00	0.46	3.38	1
SU5-100-1	1.26	+/-	0.18	0.29	2.74	1
SU5-101-1	0.57	+/-	0.15	0.24	3.43	1
SU5-102-1	0.70	+/-	0.13	0.26	3.30	1
SU5-103-1	1.10	+/-	0.18	0.33	2.90	1
SU5-104-1	1.18	+/-	0.17	0.27	2.82	1
SU5-105-1	0.58	+/-	0.16	0.26	3.42	1

Mean	**0.79**	***Sign Test Statistics***	
Median	**0.75**		
Min	**0.17**	***Sum of Positive Signs***	**21**
Max	**1.26**	***Sign Test Critical Value for N=21***	**14**
Std Dev (1 σ)	**0.28**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	17
MARSSIM Classification	1

Th-232 $DCGL_W$	4.0

	Th-232				
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU17-01-1	1.44	+/-	0.15	0.17	2.56	1
SU17-02-1	1.39	+/-	0.13	0.25	2.61	1
SU17-03-1	1.27	+/-	0.16	0.23	2.73	1
SU17-04-1	1.38	+/-	0.14	0.25	2.62	1
SU17-05-1	1.18	+/-	0.13	0.24	2.82	1
SU17-06-1	1.40	+/-	0.13	0.24	2.60	1
SU17-07-1	1.58	+/-	0.18	0.25	2.42	1
SU17-08-1	1.34	+/-	0.16	0.26	2.66	1
SU17-09-1	1.25	+/-	0.13	0.28	2.75	1
SU17-10-1	1.61	+/-	0.18	0.27	2.39	1
SU17-11-1	1.20	+/-	0.15	0.23	2.80	1
SU17-12-1	1.60	+/-	0.18	0.28	2.40	1
SU17-13-1	1.41	+/-	0.17	0.33	2.59	1
SU17-14-1	1.01	+/-	0.13	0.20	2.99	1

Mean	**1.36**	***Sign Test Statistics***	
Median	**1.38**		
Min	**1.01**	***Sum of Positive Signs***	**14**
Max	**1.61**	***Sign Test Critical Value for N=14***	**10**
Std Dev (1 σ)	**0.17**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

SURVEY UNIT DATA SUMMARY & SIGN TEST WORKSHEET

Year	2007
Survey Unit #	18
MARSSIM Classification	1

Th-232 DCGL$_W$	4.0

	Th-232				
Sample ID	**Gross Result (pCi/g)**			**MDA (pCi/g)**	**DCGLw-Result**	**Sign Test Parameter[1]**
SU18-01-1	1.39	+/-	0.15	0.25	2.61	1
SU18-02-1	1.17	+/-	0.15	0.23	2.83	1
SU18-03-1	1.14	+/-	0.15	0.29	2.86	1
SU18-04-1	1.59	+/-	0.17	0.25	2.41	1
SU18-05-1	1.26	+/-	0.15	0.23	2.74	1
SU18-06-1	1.93	+/-	0.16	0.27	2.07	1
SU18-07-1	1.07	+/-	0.16	0.22	2.93	1
SU18-08-1	1.37	+/-	0.15	0.29	2.63	1
SU18-09-1	1.15	+/-	0.15	0.26	2.85	1
SU18-10-1	1.02	+/-	0.14	0.23	2.98	1
SU18-11-1	1.01	+/-	0.15	0.25	2.99	1
SU18-12-1	1.10	+/-	0.15	0.23	2.90	1
SU18-13-1	1.14	+/-	0.15	0.23	2.86	1
SU18-14-1	1.17	+/-	0.15	0.23	2.83	1

Mean	**1.25**	***Sign Test Statistics***	
Median	**1.16**		
Min	**1.01**	***Sum of Positive Signs***	**14**
Max	**1.93**	***Sign Test Critical Value for N=14***	**10**
Std Dev (1 σ)	**0.25**	***Survey Unit Evaluation***	PASS

Notes: [1] If Th-232 result > DCGLw, then Sign = -1, otherwise Sign = 1

APPENDIX B

HP INSTRUMENTATION QUALITY CONTROL

Morris, William J CIV SEA 04 04N

From: Morris, William J CIV SEA 04 04N
Sent: Tuesday, January 15, 2008 3:47 PM
To: 'Horton, Dave CIV USA AMC'
Cc: Doremus, Steve W CIV SEA 04 04N; Lowman, Laurie L CIV SEA 04 04N
Subject: RE: WP-019548 Approval of the GLNTC waste stream >> re: Great Lakes Monazite Sand

In reviewing NUREG 1717, the highest exposures occur during dust generating operations. The NRC Safety Evaluation Report concludes that the AEC licenses were issued to package and ship the monazite sand. The packaging and shipment include operations that would generate dust. The licenses were issued for short periods only during loading and packaging operations. Consequently, the monazite sands (the material) was not licensed, just the operations that would generate dust and exposure.

William J. Morris, CHP
NAVSEADET RASO
Office 757-887-4692
Desk 757-887-7741
FAX 757-887-3235

-----Original Message-----
From: Horton, Dave CIV USA AMC [mailto:david.r.horton@us.army.mil]
Sent: Tuesday, January 15, 2008 13:37
To: Morris, William J CIV SEA 04 04N
Cc: JWeismann@cabreraservices.com; Fillingame, Wade; Eberlin John; Doremus, Steve W CIV SEA 04 04N; Lowman, Laurie L CIV SEA 04 04N; Faust, Nancy CIV USA AMC; Horton, Dave CIV USA AMC
Subject: FW: WP-019548 Approval of the GLNTC waste stream >> re: Great Lakes Monazite Sand
Importance: High

Bill,

For waste acceptance/profiling purposes, the disposal site, WCS is asking whether the material is licensed or if it ever was licensed.

Let me know from your standpoint what you think the answer should be.

Before I read what Joe Weismann said below, I had provided the following answer.

I do not think that WCS would have a problem with hearing that it once was licensed, but that it is no longer covered by a license. Let us know your thoughts on this.

My previous response to the question:

You are correct. The date the license was terminated I think is in the historical report or one of the other project documents. Let me know if you can not find it.

I would maybe add to that sentence the following: The material is not currently covered by any NRC or agreement state license.

David Horton
(309) 782-1759 DSN 793-1759

-----Original Message-----
From: Weismann, Joe [mailto:JWeismann@cabreraservices.com]
Sent: Tuesday, January 15, 2008 11:15 AM
To: Fillingame, Wade; Eberlin John; Horton, Dave CIV USA AMC
Subject: RE: WP-019548 Approval of the GLNTC waste stream

All;

I found the following language in a previous WP (from the HSA):

"On July 12, 1974, the Atomic Energy Commission (AEC) granted a license (License No. SMC-12078179) to Engelhard Minerals & Chemicals Corporation, authorizing "Repackaging of monazite sands in DOT approved containers." These operations were confined to the following locations:
Savannah Army Depot, Savannah, Illinois; Army Ammunitions Plant, Ravenna, Ohio; and U.S. Navy Administrative Command, Supply Depot (currently referred to as Naval Station Great Lakes), Great Lakes, Illinois. The former AEC license indicated that 1,826,153 pounds of monazite containing 9.226% of thorium oxide was held at the Naval Station prior to its assumed shipment offsite. Records show that monazite sand was shipped to W.R. Grace & Company, Chattanooga, Tennessee. No records have been found indicating that a closeout survey of the monazite sand storage area (current Site) was conducted, excluding Site surveys performed by Cabrera."

This indicates to me that the license pertained only to packaging and shipping (for DOT compliance and accountability). If there was no radioactive materials storage license in place at GLNTC for these sands, then I think we can answer 'No' to the "was this material ever licensed?" question. However, there's the source material exemption (unimportant quantities) that we can use if WCS continues to be difficult. We'd just have to show that it's < 0.05% by mass.

-Joe

Joe Weismann, CHP

Cabrera Services, Inc.

29 Railroad Ave.

Middletown, NY 10940

(v) 845-956-0095

(f) 845-956-0277

(m) 914-489-6128

From: Fillingame, Wade
Sent: Tuesday, January 15, 2008 11:59 AM
To: Weismann, Joe; Eberlin John; 'Horton, Dave CIV USA AMC'
Subject: FW: WP-019548 Approval of the GLNTC waste stream

Please see the question below regarding licensing of the material. I need to make sure we give the correct answer on this one.

I think the answer is:

The material was licensed by the AEC, the AEC license was terminated in {need date}. The material is not currently subject to any license.

Please confirm

-----Original Message-----
From: Kathy Purvis [mailto:kpurvis@wcstexas.com]
Sent: Tuesday, January 15, 2008 11:39 AM
To: Fillingame, Wade
Subject: WP-019548 Approval of the GLNTC waste stream

Please read below. We need to add the Th-232 to the profile so it can be sent to the state. Also, was the waste ever licensed? Thank you.

Kathy Purvis

Customer Service Representative

Waste Control Specialists, LLC

(505) 394-4300, Ext. 187

kpurvis@wcstexas.com

-----Original Message-----
From: Bill Dornsife [mailto:BDornsife@VALHI.NET]
Sent: Monday, January 14, 2008 4:41 PM
To: Kathy Purvis
Subject: RE: WP-019548 Approval

Probably should put the Th-232 on the profile as inferred from the Ac-228 since this is the radionuclide of concern. The rest looks fine. The only other question to address is whether the material was ever licensed.

From: Kathy Purvis [mailto:kpurvis@wcstexas.com]
Sent: Mon 1/14/2008 2:55 PM
To: Bill Dornsife
Subject: WP-019548 Approval

Attached information is the 1st of 3 emails.

Kathy Purvis
Customer Service Representative
Waste Control Specialists, LLC
(505) 394-4300, Ext. 187
kpurvis@wcstexas.com